An Editorial Jaunt over the Line of the South Pennsylvania Railroad.

Fifty years ago, a drive of two hundred miles or more, from the Cumberland Valley to Pittsburg, would hardly have been considered as worthy of mention; in fact, it was too much of an every day occurrence. But in this day of steam, in the hurry and dash of our present mode of life, such a trip is an enjoyable novelty, and forcibly recalls the leisurely methods of past generations, before railroads were, and the telegraph and other electric wonders more than the dreams of a few wise men. We have just made this journey as our fathers made it, and propose to tell what we saw.

The southern tier of Pennsylvania counties covers a region famed for its beauty of scenery, and filled with the traditions of colonial days; stories of Indian raids and massacres, of the exploits of the sturdy frontiersman, of the French and Indian wars of the middle of the last century, of Washington, Braddock, Forbes and Bouquet. But of all this only memory remains and the suggestive local names of villages and streams and mountain tops. To the unthinking stranger, Forts Littleton, Loudoun, Ligonier, Cumberland and Bedford mean nothing but empty names of modern towns. But they cover the sites of actual fortresses, christened in honor of old-world heroes, and forming links in a chain of similar works extending from Fort Lowther, in Carlisle, in fact, from Easton on the Delaware, to Fort Pitt on the then remote Ohio. They were barriers against Indian raids and in part against French aggression, and served as rallying points for settlers harrassed by a savage foe now long driven from this region. Burnt Cabins, Standing Stone and Bloody Run have each their story to tell, and Braddock's Road is still a travelled highway.

But through this land of story and directly along the path we followed, another army is making its way, greater in numbers than Braddock's and better generaled; yet like the forces of that unfortunate commander, this modern host is also cutting a road to the site of Fort Pitt. But the new highway is on a grander scale; it pierces the very bowels of the mountains and leaps the deep gorges in a manner typical of the advance of humanity in the years that have intervened.

It is through this country that the South Pennsylvania Railroad is being built, and a general tour of inspection over its line was really the purpose of our visit and forms the text proper of our remarks.

The new railroad commences in Harrisburg, and crosses the Susquehanna River on the very ferry site established by John Harris in 1705. The piers of the bridge, substantial and handsome in appearance, are just being completed, and from the southern end of this structure the line follows down the Cumberland Valley to a point below Carlisle, and gradually climbing the eastern slope of the Blue Mt., pierces this mountain and the Kittatinny by a pair of tunnels so close together as to be called the "Twins." From this point westward to Pittsburgh the road pursues its way through mountain ranges and along mountain crests on the route generally indicated on the accompanying map.

As a prospective route for a great railroad to the West the line now being built is no new thing save in the very important feature of actual construction. As long ago as 1837 Hotner Hage made a survey for a railroad from Chambersburg to Pittsburgh by order of the Legislature of Pennsylvania. His location in part occupied the ground being built upon to-day, but in his effort to serve too many masters and meet widely scattered local demands, his route was too crooked to suit even the men who in preference selected the present devious line of the Pennsylvania R. R. through the mountains.

The old Hage Report to the Legislature still exists and from it we find that he made the distance from Chambersburg to Pittsburg 240 miles; that the maximum gradient was 60 ft. per mile and only half of the line exceeded 40 ft. per mile. He estimated for three tunnels, and the total cost was to be $11,305,789.89. His prices were low enough; he figured excavation at 11 to 12½ cts. per cu. yd., embankment, 10 to 14 cts., loose rock, 45 to 50 cts., solid rock 55 to 80 cts., and culvert masonry $1.50 to 3.00. His superstructure was to be an "H" rail 45 lbs. per yd. laid on 3 × 9 in. locust longitudinal sills, with 6 × 6 in. locust crossties spaced 20 in. between centers, with 4 in. of broken stone ballast beneath. This track was to cost $9,755.55 per mile.

Subsequently, about the year 1844, the State employed J. L. Schlatter to make surveys for a railroad from Harrisburg to Pittsburgh. Extensive operations were conducted in the field by him and his assistants over the then called "Southern Route" from Chambersburg across Cowan's Gap into the waters of the Little Aughwick Creek; thence along Aughwick Creek and Sideling Hill Creek passing by Wishart's Gap into Sherman's Valley, the waters of which flow into the Raystown Branch of the Juniata near Piper's Run, and thence the line, following the Raystown Branch, reached the base of the Alleghanies and ascended their Eastern slope to the Summit of Will's Creek; thence following the Castleman's River and the Youghiogheny and Monongahela Rivers to the Pittsburgh and Connellsville Railroad. Nothing further was done until the organization of the Pennsylvania Railroad Company in 1846. In the following year this Company made an examination of the different routes from Harrisburg indicated by all the former surveys and came to the conclusion to reject the Southern route and adopted the route by the valley of the Juniata as presenting greater facilities and less distance than any other, and commenced construction.

The southern route lay dormant until the year 1854 when the Duncannon, Landisburg and Broad Top Railroad Company was organized and chartered and became the actual parent of the present company. In 1855 the name was changed to that of the Sherman's Valley and Broad Top Railroad Company and in 1857 the Legislature authorized this company to extend its line by the most practicable route and connect it with the Connellsville and Pittsburgh railroad, and also with the Allegheny Portage Railroad, and to construct lateral roads. In 1859 the title was again changed to the Pennsylvania Pacific Railway Company. This company retained all the rights and privileges previously granted and was authorized to extend its line westward to the State Line of Maryland and of Virginia. In 1863 the name was finally changed to that of the "South Pennsylvania Railroad Company" and during the last session of the Legislature, general laws were passed under which the powers of the company were greatly extended and authority was obtained which enabled it to adopt the shortest possible line between Harrisburg and the State Line of Virginia and Pittsburgh. The various extensions and renewals granted to the company seem to have been greatly due to the personal efforts and watchful interest of Colonel James Worrell, a veteran civil engineer now a resident of Harrisburg. He had assisted Hage in his original surveys in 1837 and 1838, and always maintained the most lively interest in the Southern route. He became President of the South Pennsylvania Railroad Company about the year 1860 and made some reconnoissances and surveys of his own between Chambersburg and Pittsburg, and advanced some bold theories for the engineering of the route.

During the period between 1860 and 1880, the controlling stockholders of the organization were the McCalmont Brothers of London who had subscribed for the majority of the stock, and paid in in cash the first instalment thereon. Practically, this gave the control to the officers of the Philadelphia and Reading Railroad Company, and so matters remained until some time in 1881 when the subscription book was opened and large additional subscriptions were made by parties representing capitalists in the State of New York. Surveys were commenced under the supervision of Oliver W. Barnes of New York, Civil Engineer, with a large force, and sufficient data was obtained to enable him to report that a new and better line had been discovered than any that had been heretofore known, and upon this report being placed before capitalists, subscriptions to an amount sufficient to construct the road were obtained and the company was reorganized with abundant capital.

Mr. Barnes was selected as the Chief Engineer of the Company, and was authorized to survey and locate the line upon the route he had recommended, but in order to make assurance doubly sure, the most thorough exploration was made of every practicable route and side line which presented itself, or which was advocated by intelligent persons along the line, before finally adopting the location now under construction. A belt several miles in width was covered by these surveys, and its rugged topography carefully mapped and lines were estimated upon and compared in the most careful manner.

One of the striking features which is presented to the mind of the engineer in considering the adopted location is that it is a "summit line" for a large portion of the way and instead of following the devious windings of the mountain streams as does its older brother, the Pennsylvania Railroad, it cuts through the mountain ranges which cross it at right angles and seeks the crests of the water sheds. This is so much the case that through the region between the Tuscarora Mountain and Sideling Hill, and again between the Allegheny Mountain and the Chestnut Ridge over a wide stretch of country, we failed to discover a single water-way passing under the road bed for which a 12 ft. opening was not more than ample. There is not an iron bridge on these crest lines for more than 40 miles. This simple fact speaks for itself as a measure of economy and locating skill.

This location is the more remarkable when we consider that the main direction of the railroad strikes the ridges almost at right angles to their axes, and speaks volumes for the patience, perseverance and professional skill of the engineers in charge. They seem to have considered all the parts of the difficulties to be surmounted in their relation to one another and settled upon a conclusion derived from the entire truth. No line seems to have been adopted until all the logical relations and dependencies were completely understood. The great advantage of this line is in the fact that it is not confined to the narrow limits of the valley but is a direct "across country line" on ground rejected by all previous surveyors, scarcely a mile of it having ever been occupied by their locations. Some of them thought they had satisfactory lines because they were cheap, but so extended was their length and so steep their ruling grades that had they been able to raise the money to build on them they would not only have been financial failures, but they would have left the best ground unoccupied to be taken advantage of by more skillful and enterprising engineers.

The final reports having been submitted by the chief engineer during the summer of 1883, a contract for the construction of the whole line was made with the American Construction Company, an organization perfected under the laws of the State of New Jersey, and the work has since been prosecuted under that contract by sub-contracts with practical and experienced contractors, distributed at various points along the line.

We regret that we cannot enter more fully into the detail of the organization and practice followed in the construction of the road, for we could detect on all sides, even in our hasty trip over the line, ear-marks of the most careful and thorough supervision, such as might be expected from the unusually strong combination of professional talent having its works in charge. But both data and time were wanting for our task, and as yet we could only review uncompleted structures.

There are seven long tunnels contemplated and two shorter ones. This, of course, is the most important feature of the line as to time of completion of the road, and in them we observed that the work was being pushed to its utmost. With the exception of the Negro Mountain and Quemahoning Tunnels, the two short ones, all the headings and tunnel enlargements were well under way as will be seen from the accompanying table:

Tunnel.	Finished Length	Progress both ends Sep. 6th.	Name of Contractor.
Blue Mt.	4240 feet	350 feet	Mason, Hoge & Co.
Kittatinny	4620 "	850 "	Evans & Ackerman.
Tuscarora	5225 "	750 "	Mason, Gooch, Hoge & Co.
Sideling Hill	6662 "	560 "	O'Brien & Rodgers
Rays' Hill	3534 "	570 "	McMahon, Shanahan & Green.
Allegheny Mts.	5960 "	1060 "	Chas. McFadden.
Laurel Hill	5400 "	700 "	Patterson & Kuhn.
Negro Mt.	1100 "	0 "	John McGovern.
Quemahoning	800 "	0 "	P. & T. Collins.

All of the tunnels are being worked by compressed air drills, or preparations are nearly completed for their introduction. In this connection we noticed that the Ingersoll Rock Drill Company of New York had decidedly the lion's share in the furnishing of the compressor and drill plant, but one other company being represented at all on the line of the work. In the Sideling Hill and Allegheny Mountain Tunnels the electric light is used, the first time we ever saw it adopted on work of this nature. It is employed mainly in lighting up the finished tunnel, the deep shadows resulting from it making oil lamps still preferable at the working face. The old-fashioned top-heading is the rule among all the contractors, the bottom-heading and side enlargement adopted with such remarkable success in the piercing of the Arlberg tunnel not yet having found favor with American contractors. Very considerable timbering has been so far required, and the nature of this timber work is such as at once to attract the attention of the engineer. It is permanent, to the extent of about 7 years, and is located entirely outside of the proposed masonry, permitting this last to be put in place when suitable material can be transported over the finished road. Brick-yards, however, are being started near several of the tunnels, and the product will be largely used on the line of the railroad, good stone being exceedingly scarce over many sections. The timbering in place near the portals of the tunnels presents an exceedingly neat appearance, and as represented upon the plan, takes a minimum of space outside the line of the masonry. The sets are placed about 30 inches between centers usually, and they are tied together longitudinally by 5 × 6 in. ties, shown in the cut, which are jogged down 3 in. over the arch timbers. The radial joints of the arch timbers are cut to a template and very accurately fitted; being well packed above the lagging, no tie-plates were necessary over the joints, at least we did not notice any. The timbering however, varies in design with the character of the ground to be held; when very bad the usual caps, posts and rakers are employed.

The tunnel section, which is all for double-track, is sufficiently illustrated so as to require no further description.

The arched masonry upon the line of the road, some of which is started, attracts attention from the peculiar form of the opening, which is ovoid instead of full-center or segmental. This design has been adopted after careful study by the Associate Engineer, Mr. Wm. F. Shunk, as being not only more economical of material than the usual form, but as being really stronger than with the ordinary dimensions; the arch is struck from three centers and is so designed that the line of pressure falls within the middle third of the arch. This is another evidence of the care and attention to detail and proper economy in construction characteristic of the present engineering management. Another new departure was noticed in the "box-drain" plans; as mentioned, stone of suitable character is very scarce, and covering stone proper for use in these drains so difficult to get that their cost is prohibitory. But here again Mr. Shunk has brought into play his strong common sense and has utilized a tough but thin laminated stone found in the neighborhood; he has substituted arches and walls of this stone laid in full cement for the usual covering stone and heavy side walls, reasoning that as the Romans used thin tile and good cement for some of their most lasting work this same construction would do good service here. It is a hint worth remembering.

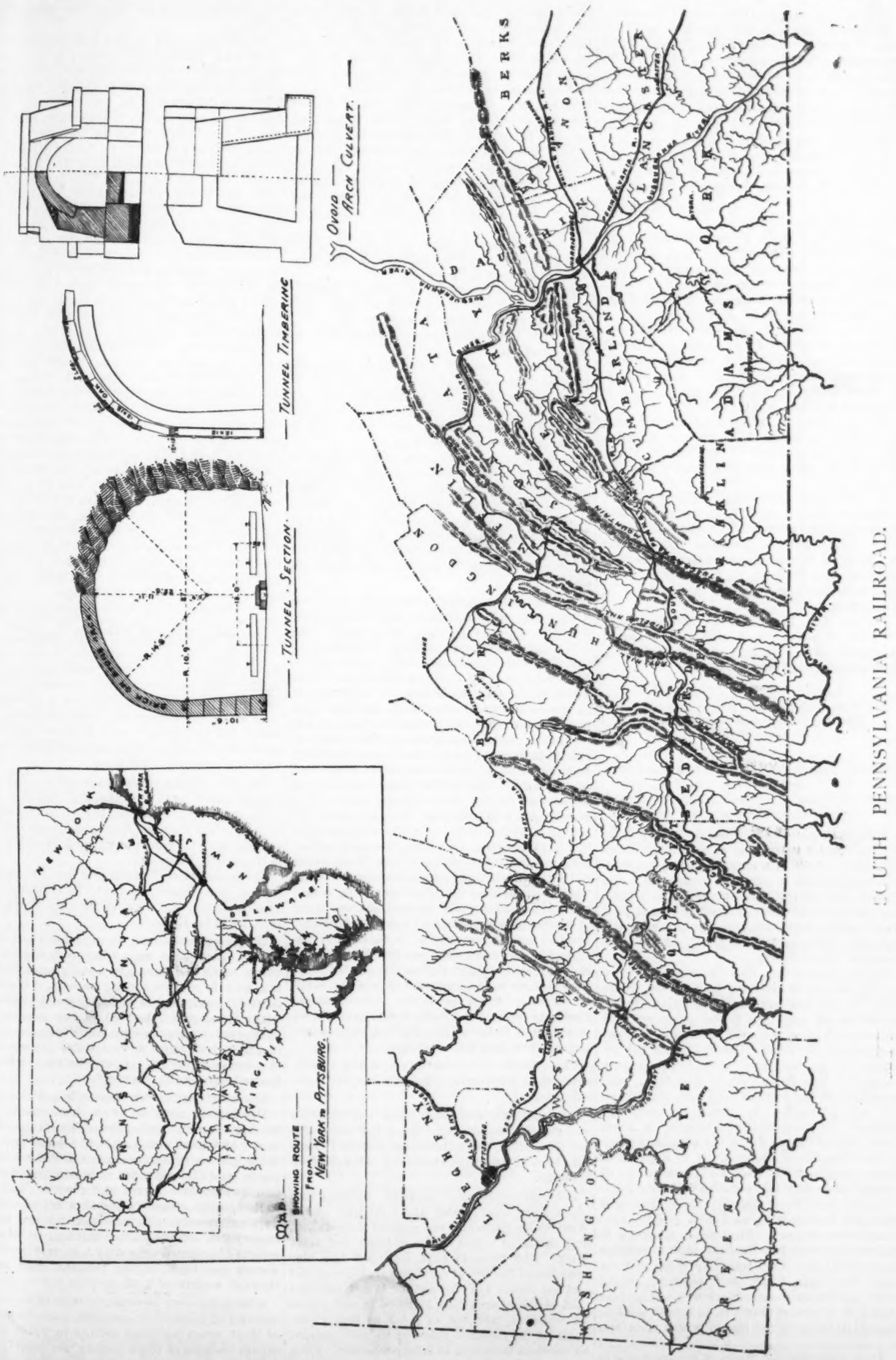
Outside of the tunnels, there is some exceedingly heavy work in the shape of grading. One of the most formidable cuts is near the Allegheny tunnel, and is worked by the same contractor, Mr. Chas. McFadden; it is a rock thorough cut 94 ft. deep. Brodhead, Byron & Co. also have about 8 miles of heavy work near Fort Littleton. They are using a steam excavator with advantage. The contractors engaged in the construction of the South Pennsylvania Railroad, other than those mentioned in connection with the tunnel, are James Smith, building masonry for the Susquehanna Bridge; Mason, Rinehart & Co., Sections 62-66; Brodhead, Byron & Co., Sections 67-74; Chas. McFadden, Sections 120-130; Shields & Dorwin, Sections 140-142; P & T Collins, Sections 143-154; D. Paige & Co., Sections 161-168. These contracts practically include all the heavy work, those which are likely to consume time. The remaining sections, including the entire Cumberland Valley Division, work upon which is very light, will doubtless be let at such time as the advance of the heavier work will warrant.

In summing up the results of our trip over the South Pennsylvania Railroad we give some general data picked up by the way. The distance from Harrisburg to Pittsburgh will be 213 miles. The highest elevation attained is at the Laurel Hill Tunnel 2444 feet above tide. The Allegheny Mountain Summit is not quite so high, being but 2345 feet above tide. The maximum gradient is 52.8 ft. going west from Harrisburg until the foot of the Allegheny Range is reached at New Baltimore where the ascent is made at the rate of 96 ft. per mile on a plane 10 miles in length. The Allegheny Summit having been reached a maximum of 26⅖ ft. per mile is used over the undulating ground along the divide between the Allegheny Mountains and Laurel Hill. The descent of the western slope of the Laurel Hill required the use of 105 ft. per mile for a distance of 6 miles; this puts the line fairly on the crest of the connecting ridge between the Laurel Hill and the Chestnut Ridge; then to descend from the Chestnut Ridge into the water shed of the Sewickly, 105 ft. per mile is again resorted to for a distance of 6 miles; the foot of this grade lands the line down into the Youghiogheny Valley, thence 52⅘ is used with all undulations to the point of connection with the Pittsburg, McKeesport and Youghiogheny Railroad at Port Perry on the Monongahela River, 11 miles south from Pittsburgh, and two hundred and three miles west of Harrisburg; the grades from Port Perry to Pittsburgh being only 16 ft. per mile. The maximum curvature is 6 degrees. All grading and tunnels are for double track. The labor is abundant (6,000 men are said to be employed) and is made up mainly of Italians, Hungarians and negroes. The old time Irish railroader is conspicuous by his absence, seemingly very few of them being at work, though the gang bosses, foremen and superintendents are generally of the old-fashioned class.

And last, but by no means least, we come to the engineering department of this really remarkable railway enterprise. Among the division and resident engineers and their corps, we met several old friends and made a number of new acquaintances, and about these gentlemen center the pleasantest memories of our generally enjoyable trip. They are picked men, selected from an army of applicants, for their especial fitness for the laborious and intelligent work required. Many of them have been on the road since the first surveys were begun by the Chief Engineer, Mr. Oliver W. Barnes, in December, 1881, and from all indications they possess an unlimited capacity for solid and continuous engineering labor. If the would-be civil engineer imagines that the superintendence of the construcion of a road, such as this, is holiday fun, we advise him to take the jaunt we did, and we promise that he will change his mind on that head at least. The S. P. R. R. is divided in its entire length into 6 divisions, with a Division Engineer at the head of each; each division is again divided into 4 sub-divisions, with a Resident Engineer in charge of each. This arrangement gives each Division Engineer from 30 to 35 miles to attend to, and each Resident and his corps from 8 to 10 miles, depending upon the character of the work. As the route is generally mountainous, the roads rough, and, as in some cases, two tunnels fall to the share of one Resident, the engineering forces have little, if any, idle time. If to the hard work is added the meagre accommodation and personal discomfort usual to such a region, it will be seen that the engineer's lot "is not always a happy one." But notwithstanding all the drawbacks mentioned, the men we met were making the best of it, and seemed to enjoy it, with all the proverbial careless good-nature of the craft. The "last sweet thing" in headquarters we encountered was a very unpromising old, log tannery transformed by patient labor, good taste, curtains, pictures from all sources and improvised wall paper into a very snug Residency for Sub-division 4 C.

Of the men who created this engineering department and controlled, and yet control, its movements in the location and construction of the most difficult and important road of its length in the country, we need say but little. Their names are known for the deeds they have done, throughout the professional and railroad world. They undoubtedly combine the strongest professional talent, and best trained practice ever put at the head of an American railway, and under their guidance this new trunk line cannot fail to be a model for the future study of the engineering profession.

The organization of the company at the time the contract for construction was entered into, October 1st, last, was somewhat changed.



SOUTH PENNSYLVANIA RAILROAD.

Mr. R. H. Sayre was then elected President and Chief Engineer of the Company, and William F. Shunk, who had formerly been Chief Assistant to the Chief Engineer, Mr. Oliver W. Barnes, was made Associate Engineer, and Mr. Barnes was made Consulting Engineer, so that the organization and personel of the Engineer Department is as follows:

Robert H. Sayre, Chief Engineer.
Oliver W. Barnes, Consulting Engineer.
William F. Shunk, Associate Engineer.
Thomas H. Loomis, Assistant Engineer.

Division One: T. C. Ives, Resident Engineer. Harrisburg, Pa.

Division Two: W. H. Atwood, Division Engineer, Fannetsburg; W. M. Hall, Resident Engineer Sub-Division A., Roxburg; C. N. O. Whitney, Resident Engineer Sub-Division C., Fannetsburg; S. R. Patterson, Resident Engineer Sub-Division D., Ft. Littleton.

Division Three: F. H. Clement, Division Engineer, Everett; J. J. Hoopes, Resident Engineer Sub-Division A., Dublin; S. H. Chauvenet, Resident Engineer Sub-Division, B., Rays Hill; C. Gaylord Thompson, Resident Engineer Sub-Division C., Everett.

Division Four: E. H. Barnes, Division Engineer, Dividing Ridge; J. M. Rudiger, Resident Engineer Sub-Division C., Mt. Healthy; C. E. Webster, Resident Engineer Sub-Division D., Stony Creek.

Division Five: J. Imbrie Miller, Division Engineer, Somerset; S. L. F. Deyo, Resident Engineer Sub-Division A., Kimmel's House; U. S. Lutz, Resident Engineer Sub-Division B., Weller's House; Jno. Marston, Resident Engineer Sub-Division C., Laurel Hill; C. W. Stamford, Resident Engineer Sub-Division D., Jones Mill.

Division Six: E. M. Leuffer, Division Engineer, Mt. Pleasant; W. R. Hill, Sen. Assistant Engineer, Mt. Pleasant; G. B. Campbell, Resident Engineer Sub-Division A.

The New York, West Shore and Buffalo Railway, and the Methods Used in its Construction.*

BY PETER CHALMERS COWAN, B. SC., EDINBURGH, STUD. INST. C. E.

(*Continued from page* 148.)

Wharton's patent switches and spring frogs are used on the main line of the West Shore Railway. These in a great measure prevent, by securing an unbroken bearing for the wheels, the jolting so destructive to wheels and rails, and so uncomfortable to passengers, which occurs with ordinary switches and frogs; they also minimise the dangers from the carelessness of switchmen.

Cattle guards are, like "cow catchers," a special feature of railways in America, where there are no Parliamentary Standing Orders requiring all crossings to be provided with gates which close the road when the railway is clear and *vice versa*. Cattle guards are intended to prevent the cattle from straying along the line from "grade crossings," and usually have the form of open pits or culverts, 4 ft. wide, bounded by cheap masonry and bridged by wrought-iron I beams. A novel form of guard is shown on the standard plans of the West Shore Railway. It is a gridiron frame constructed of hard wood scantlings of triangular section laid parallel with the rails.

On the West Shore Railway three classes of masonry for retaining-walls and bridge abutments were defined. First-class masonry is specified as rock-faced ashlar laid in regular horizontal courses not less than 10 in., and not more than 30 in. thick, and having parallel beds and vertical joints. Stretchers are not less than 2½ ft. nor more than 6 ft. in length, not less than 1½ ft. in width nor less in width than one and a quarter time their depth. Headers must not be less than 3½ ft., nor more than 4½ ft. in length, not less in width than 1½ ft., nor less in width than their depth in course. The joints must not exceed ¼ in. in thickness. The bed-joints are to fit close for at least 8 in. in from the face. Cement mortar is used in laying the stones, and each course is grouted before it is covered. The backing is specified to be of good-sized well-shaped stones laid so as to break joint and thoroughly bond the work in all directions, and leave no spaces more than 6 inches. Any space left between the stones are to be filled with small stones well grouted.

All foundation courses must be laid with large flat stones at least 12 in. thick and with a bed of at least 15 sq. feet.

Second-class masonry is "broken range" rubble of superior quality with no stone less than 8 in. thick, and no joint wider than ¾ in., and with foundation-stones with beds of at least 12 sq. feet.

Third-class masonry is defined as good substantial rubble work of sound stones laid on their natural beds, and sufficiently large to make well-bonded strong work. The stones in third-class foundation must have each a bed-area of at least 10 sq. feet.

By order of the State authorities first-class masonry was used in the abutments of the bridges carrying the railway over the canals. Second-class masonry was used in the bodies of other abutments, and generally also for the wings. Third-class masonry was employed for light highway bridges, in box-culverts, and sometimes for the wing-walls of railroad bridge abutments.

The coping projection was 6 in., and the wing-walls are covered by steps 1 ft. thick, 2 ft. 3 in. wide, overlapping one another 1 ft., and projecting 3 in. on the face. The batter of the face was from ½ in. to 1 ft. to 2 in. to 1 ft. The rule laid down in the specifications of the West Shore Railway is almost the same as that used on the Pennsylvania Railroad and the Erie Railroad; the thickness of the wall at all points to be four-tenths of the height to subgrade from the point considered. Generally however, after fixing the thickness at the foot of the wall by this rule the back was stepped off at the rate of about 1 ft. to every 4 ft. of rise; to give a thickness at the top under the coping of 1½ ft. to 2 ft. for a backwall, and 2 ft. to 3 ft. for a bridge seat. No "weeping holes" are provided in the walls on the West Shore Railway, and the banks were usually carelessly "dumped" behind the abutments. In consequence, a good many of the walls showed signs of distress by cracking and pushing forward; and the certain conclusion is that walls designed by the rules used on the West Shore Railway are too light, unless the mortar is allowed ample time to set; and unless the earth is carefully filled in layers behind them. Probably none of the walls would have shown weakness if the practice of piling loose stones behind them had been followed.

The culverts are of four kinds, namely, arch-culverts, box-culverts, open-culverts, and pipe-culverts.

Open-culverts are used when considerable waterway is required through a low bank, and are formed of two third-class masonry walls 4 ft. to 6 ft. apart, spanned by wrought-iron I-beams.

For pipe-culverts, vitrified earthenware pipes were used under the first half of the West Shore Railway; but some of these failed, and cast-iron pipes were ordered for later work. The Pennsylvania Railroad has also abandoned the use of earthenware pipes under embankment; but the author is not satisfied that earthenware pipes, fortified in soft places by concrete, are not as good as iron pipes. Some of the failures referred to were caused by careless insertion in frosty weather. Even with a liberal allowance of concrete, the earthenware pipes are much the cheaper expedient.

The timber used in the foundations were white oak, yellow-pine, spruce, or hemlock. The last variety was most commonly used for foundation platforms; it is cheaper than the others, and lasts well in wet positions. The piles are specified to be at least 12 in. in diameter at the butt, and 8 in. in diameter at the small end; and to be driven until they do not move more than ¼ an inch under the blow of a 2,000 lb. ram falling 25 ft. This last requirement was never, or very exceptionally, fulfilled; the usual effect of the last blow was to drive the pile 1 or 2 inches. The piles are driven with the small ends down, and are not peeled. Piles of 60 to 70 ft. in length, and of maximum diameters ranging from 15 to 18 in. are commonly used in American work. In a few places where layers of hard materials had to be pierced, the piles were shod with cast iron hollow conical points, 10 in. long, and weighing about 18 lbs. The load allowed upon each 12 in. pile, moving say 2 in. under the last blow, was 7 to 9 tons. The author imagined Rankine's rule, allowing 200 lbs. per sq. in. of head, or about 10 tons for a pile 12 in. in diameter, a safe load for piles "standing in soft ground by friction," to be a very safe one, until he found that an abutment, weighing 1,400 tons, supported on two hundred and ten piles, each 1 ft. in diameter, and 60 to 70 ft. long, driven in white marl, had tipped back so as to increase the span by 6 in., and that this wall and its companion had settled from 4 to 6 inches. The walls were 30 ft. high from the bridge-seat to the timber foundation platform. The settlement mentioned took place before any trains had come on the bridge.

The crossing of the Seneca River, a barrier well known on account of its difficulty, afforded much experience in soft foundations.

The West Shore Railway effected this crossing by twenty spans of 50 ft., with pile foundations. The ground, which is mostly soft, varies irregularly. At one spot a pile 40 ft. long would bring up on hard bottom, and split under the hammer, while 4 ft. from this pile, another, 90 ft. long, would be fully driven, and sink 6 in. under the last blow.

The New York Central Railroad crossed the Seneca River by 15 ft. spans, and founded the piers on a continuous timber platform, sunk in a levelled trench. The piers have settled greatly, and very unequally, and blocking up is frequently necessary.

The foundation-platforms on top of the piles in the West Shore railway foundations at Seneca River, are formed by two layers of 10 in. by 12 in timbers.

Wooden trestle-work is used for short distances on the line, as a temporary expedient where earth is difficult to obtain for embanking, and is of two kinds; namely, "timber-trestle," composed of ordinary trestle-frames, with "mud-sills" bedded in the ground, or supported on short piles: and "pile-trestle," in which long piles are partially driven into the ground, and the upper portions of them framed into trestle "bents."

The specification for cement is as follows:—"The cement must be of the best quality, of freshly burned and ground hydraulic cement, and must stand a proof tensile test of 50 lbs. per sq. in. on specimens mixed to a stiff paste, and allowed a set of 30 minutes in air, and twenty-four hours under water; and of 90 lbs. on specimens allowed a set of seven days under water. It must take not less than twenty-five minutes after mixing, to bear a weight of 4 ounces on a wire $\frac{1}{12}$ in. in diameter. Ninety per cent. of the cement must pass through a sieve of 2,500 meshes per sq. inch.

A large number of cements were rejected on account of insufficient strength; some because of their cracking after setting in water, and others because of their setting too quickly to fulfil the "wire-test." The tests were made

*From Other Selected Papers of the Institution of Civil Engineers.

with neat cement; but the author favors the opinion that mixtures of cement and sand, similar to those used in masonry, should be adopted in testing. In the masonry 1 part of cement to 2 parts of sand is specified.

The cements commonly employed in America, are "natural cements"; that is, they are obtained by burning one kind of rock containing carbonate of lime and silicates. The strength of these cements is less than that of the artificially mixed English "Portland cement." It is claimed by the manufacturers of American cements, that a mixture of their cement with sand in equal portions, is stronger than a mixture of 1 part of English Portland cement to 2 parts of sand; and that considering the relative cost, it is more advantageous to use American cements.

The price of English Portland cement delivered on the West Shore Railway works, was about 4 dollars per barrel of 300 lbs. The price of American "natural" cements, which stood the tests detailed above, is 1.30 dollar per barrel of 300 lbs.

Few railway companies in America now build their own bridges. General specifications are usually furnished by them to bridge companies, and the structures are designed by engineers who make this work their special business, and see that their ideas are carried out in the "bridge shops." The strain-sheets and detail plans are submitted by the designers to the railway engineer before the bridge is constructed. On the West Shore Railway an experienced bridge-engineer was appointed to the duties of checking the plans, and superintending the design of the masonry. The masonry plans are designed in the Railway offices.

The use of cast iron in railway bridges and in highway bridges is rapidly being abandoned in America; wrought-iron is almost universally adopted. Steel has, in a few instances, been chosen, mostly for compression members on small details. This is due to the fact, that as yet, steel of sufficiently uniform character can only be obtained at prohibitive prices. It is therefore neglected, except in such special cases as very long spans, where the weight of the girder must be minimised.

Wood is only used in the bridges in the form of sleepers and extra guard rails. The floor beams and stringers are made of built or rolled wrought iron beams. The specification of the West Shore Railway says:—

All parts of the bridge superstructure shall be of wrought-iron, except bedplates and washers, which may be of cast iron. This rule has not, however, been rigidly adhered to, as some of the pin-connected bridges, varying in span from 80 to 220 feet, have been erected by the Phœnix Bridge Company, who employ iron castings to form the joints between the posts, or vertical members, and the upper boom.

This practice is due to the fact that the Phœnix patent column, an economical form of strut, is not easily connected without the use of cast-iron joint boxes. The Phœnix column is built up of circular segmental plates, with external radial flanges riveted together to form the pillar. These columns support the highest sections of the New York City Elevated Railways. The Phœnix column, in common with other pillars of closed cross-section, has the objection that it cannot easily be painted over all its surface after erection. The importance of this defect is now well recognized, and most of the American bridge builders now use angle and trough-shaped sections braced with lattice bars for the struts in their trusses.

The following methods of bridge construction are employed on the West Shore Railway:

For spans up to 20 feet, rolled I beams.
" " from 20 to 50 " riveted plate girders.
" " " 50 to 75 " riveted lattice girders.
" " " 75 ft. and upwards, pin-connected trusses.

The widths of the bridges and the arrangements of the floors are shown in Figures 7, 8, 9 and 10. They are all about 2 ft. wider than those commonly used, on account of the tracks being spaced 13 ft. apart from centre to centre; but it has for some time been the opinion of engineers that the common widths are too narrow for the desirable amount of stability and clearance.

"Deck" bridges are always employed when the requsite headroom beneath can be obtained without much additional embanking. They are more easily braced than "Through" bridges, are less exposed to the wind, are less liable to damage from passing trains, and require less masonry. The American engineers use very deep trusses for spans over 75 ft., but are careful to supply ample lateral bracing above and below. The West Shore Railway specifications require 20 ft. clear headroom for all pin-connected through bridges, and these are consequently at least 23 ft. deep.

The pin-connected bridges on the "West Shore" Railway are of the forms most commonly used in America, and called the Pratt and Whipple Bridges.

The single intersection bridge is generally called the Pratt Bridge, and the double intersection one, the Whipple; but these and other names are often loosely used for both arrangements.

In the Pratt and Whipple Bridges the vertical members are all struts and the diagonals all ties. The struts and upper chord are formed of wrought-iron columns and latticed channel-irons, and the diagonals and lower chord of round rods and flat eye-bars. Pin-connections are used at all the joints, and the posts are sometimes riveted to the upper chord.

In American pin-connected through bridges the floors are generally arranged thus: riveted beams are hung from the pins at the lower panel points; wrought-iron rolled beams, 12 to 15 in. deep, usually two under each rail, are laid upon these cross beams; and the track is spiked upon cross-ties resting on the I beams. The cross-ties are continuous for both tracks; where possible they are usually white oak or yellowpine timber, 8 in. square in cross-section, and are spaced 16 in. apart from centre to centre. The ties are notched $\frac{1}{2}$ in. upon the I-beams and on the West Shore Railway fang-bolts fasten the timber to the iron. The bridges have no closer floor than that formed by the cross-ties.

The West Shore Railway specifications state that the bridges of the railway shall be proportioned to carry the following loads:

(1.) The weight of the iron in the structure.

(2.) A floor weighing 400 lbs. per lineal foot of track, to consist of the rails, ties and guard timbers only.

(3.) A moving load for each track, consisting of two "consolidation" engines coupled, followed by a train weighing 2240 lbs. per lineal foot.

Different bridge companies have different methods for reducing the "live" and "dead" loads to an equivalent dead load. Some engineers take out the stresses due to the sum of the dead and live loads, and add to those to allow for dynamic effect, 25 per cent. for spans of 30 ft., 15 per cent. for spans of 50 ft. and 10 per cent. for spans of about 75 ft., the addition diminishing to 0 at spans of 100 ft. A much greater load per lineal foot is always provided for in short spans than in long ones for the following reasons:—first, the speed of trains is not usually slackened when short spans are approached, and the application of the load to them is therefore almost of the nature of a blow; and second, on short spans the whole bridge is frequently covered by locomotives, while larger spans can only be covered in ordinary working by adding to one or two locomotives a portion of the lighter train, and therefore they never have so high an average load per lineal foot as the smaller spans.

On some railways the maximum load assumed is 6,000 lbs. per lineal foot of single track, for 10 ft. spans diminishing to 2,500 lbs. for 500 ft. spans.

To provide for wind-strains and vibrations, the top lateral bracing in "deck" bridges, and the lower lateral bracing in "through" bridges, on the West Shore Railway, are designed to resist a lateral force of 450 lbs. per foot of span: of this 300 lbs. is treated as a moving load. The bottom lateral bracing in deck bridges, and the top lateral bracing in through bridges, are designed to resist 150 lbs. per foot of span.

All parts of the structures are specified to be so proportioned that the maximum loads shall in no case cause a greater tension than the following:

	Lbs. per Sq. In.
On lateral bracing	12,000
On solid rolled beams used as cross-floor beams or stringers	8,000
On bottom chords and main diagonals	10,000
On counter-rods and long verticals	8,000
On bottom flange of riveted cross-girders, net section	8,000
On bottom flange of riveted longitudinal plate-girders over 20 feet long net section	8,000
On bottom flange of riveted longitudinal plate-girders under 20 feet long, net section	7,000
On floor beam hangers and other members subject to sudden loading	6,000

Compression-members are so proportioned that the maximum loads shall in no case cause a greater stress than that determined by the following formulas:

$$p = \frac{8{,}000}{1 + \frac{l^2}{40{,}000r^2}}$$ for square end compression-members.

$$p = \frac{8{,}000}{1 + \frac{l^2}{30{,}000r^2}}$$ for compression-members with one pin and one square end.

$$p = \frac{8{,}000}{1 + \frac{l^2}{20{,}000r^2}}$$ for compression-members with pin bearings.

p = the allowed compressive stress per square inch of cross-section.

l = the length of the compression-member in inches.

r = the least radius gyration of the section in inches.

The lateral struts are proportioned by the above formulas to resist the resultant force due to an assumed initial strain of 10,000 lbs. per square inch upon all the rods attaching to them produced by adjusting the bridge.

In beams and girders compression is limited as follows:—

	Lbs. per Sq. Inch.
In rolled beams used as cross-floor beams or stringers	10,000
In riveted plate girders used as cross-floor beams, gross section	6,000
In riveted longitudinal plate girders over 20 feet long	6,000
In riveted longitudinal plate girders under 20 feet long	5,000

Members subjected to alternate stresses of tension and compression are proportioned to resist each of them. The forces, however, are assumed to be increased by an amount equal eight-tenths of the smallest stress.

(TO BE CONTINUED.)

THE route of the projected line known as the Chicago, Freeport and St. Paul, is as follows: From Chicago to Freeport, Ill., in almost an air line, thence northward up the valley of the Pecatonica River, crossing the Wisconsin River near Lime Rock; thence along the north bank of the Wisconsin to the mouth of Mill Creek, in Richland County; thence northward through Boaz, in Richland County; Sparta, in Monroe County; Melrose, in Jackson County; Whitehall in Trempeleau County; Durand, in Pepin County, and River Falls, in Pierce County, to a point upon Lake St. Croix, in the town of Troy, in St. Croix County; thence in a direct line to St. Paul and Minneapolis.

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THE September rainfall in this city has been as follows in the last fourteen years, including 1884:

	Inches.		Inches.		Inches.
1871	2.13	1876	5.24	1881	1.38
1872	3.44	1877	1.33	1882	14.51
1873	2.51	1878	3.20	1883	3.57
1874	7.21	1879	1.45	1884	.15
1875	2.51	1880	2.26		

AN accident happened on the morning of Oct. 1, at Pier 9, of the new bridge being built by the B. & O. R. R., across the Susquehanna River, at Havre de Grace, Md. Pier 9 is the nearest to the eastern end of the bridge. It is being sunk in the water 50 ft. deep with 46 ft. of mud, etc, between the river bed and the rock which is finally to support it. The timber caisson used measures 76x41 ft. and upon this to and somewhat above the water surface is a cellular structure of wood filled with concrete. Through this timber work runs the air-lock shaft, 4 ft. in diameter, the supply shaft, pipes, etc., communicating with the working chamber in the caisson. Compressed air is employed to expel the water and enable the workmen to attend to their duties in excavating within the caisson.

Work was commenced upon this pier three weeks ago, by Gen. Wm. Sooy Smith & Son, the Contractors, and the caisson had penetrated about 10 ft. into the mud at the time of the accident. On the morning in question, the customary "sink" was being made, just previous to the entry of the next shift of men; this is accomplished by permitting the escape of a certain amount of the compressed air from within the caisson, so as to allow the mass to sink by its increased weight a distance usually of about 2 ft. in the material at the site of this bridge. Seven men were left inside during this operation as customary, but either from the unusually soft nature of the soil, or the escape of too much air under the circumstances—which would amount to the same thing—the cutting edge of the caisson, and consequently the pier penetrated further than expected, and almost caught the men between the mud and the roof of the caisson. All of the workmen, however, succeeded in getting into the air-lock shaft where they were safe. But as the top of the timber work, and the top of the shaft had sunk below the water surface in the river, they were imprisoned about five hours while a temporary coffer dam was being built about the top of the shaft. The connection between the compressor and the air-lock being intact, the men suffered no inconvenience except from the, to them, uncertainty of their position; no one was seriously injured, although a leak in the iron work of the lock threatened danger until stopped by the shirts of some of the men.

The Pollution of the Schuylkill River at Philadelphia.

The attention of Councils and citizens of Philadelphia is again called to the pollution of the Schuylkill River above Fairmount Dam, in a report from Col. Ludlow, Chief Engineer of the Water Department; a report based upon the late careful investigations of Asst. Engineer Dana C. Barber.

The domestic water supply of 900,000 people is taken from the portion of the river examined i. e. the Fairmount pool or the Schulykill between Fairmount and Flat Rock Dams. Analysis proves that the contamination is nearly all from within the city limits, the upper water being comparatively pure, and hence the sources of contamination are under the control of the city authorities.

The area drained into the pool is about 75 square miles and the population on this area is 50,000. The villages of Manyunk and the Falls, and the many mills and factories within their limits furnish the chief portion of the polluting element. The mills alone empty 700,000 gallons of refuse per day into the stream, and one of them scours daily 45,000 lbs. of wool, and uses in so doing from 6,000 to 8,000 lbs, of many different chemicals. A main sewer draining a number of breweries pours out its filth within 100 ft. of the intake of the Spring Garden Works, the largest pumping station in the city. Taken all together the report presents a series of abominations entering into the main source of water supply that is strangely at variance with our modern ideas on sanitation.

This showing is bad for the second city in wealth and population in the Union; and the fact that this report only repeats the warning frequently given before, each setting forth the dangers of a present and ever-growing evil, only adds to the responsibility of the authorities in charge.

Plans have been submitted from time to time for the removal entirely or the lessening of this danger, but up to the present very little of practical benefit has resulted. Some of the good people believe that because the chemists report the Schuylkill water as fully up to the average in purity, that the above reports must be exaggerated, or that at least no harm is done. But these same people complain of the mud drawn from their hydrants in times of flood, and cry out then against the water. The fact is that when muddiest, it is perhaps least dangerous to health, for the limpid water often carries the seeds of disease. Appearances are deceitful, especially in a water supply, and though mud is not palatable and should be got rid of by settlement, the mixture of chemicals and the drainage of tenements, breweries and factories with a water supply must sooner or later be productive of grave evils.

That some portion of this pollution is chargeable to the carelessness of the civil authorities of Philadelphia is evident from the report. There is no sound reason for the continuance of the sewer outlet at the water works referred to; if a blunder of a generation past so located it, or if the conditions have changed since its location, Philadelphia surely has skill and wealth enough to remedy the now very evident mistake. The health of a community should not be trifled with and sewage of all kinds should be diverted from the water supply, no matter how good the chemist's report may be. An eminent engineer says that the best method of treating a contaminated water supply is "to let it alone," the next best thing is to remove the sources of contamination when such a course is possible.

Poor's Manual for 1884.

In reviewing the 17th number of Poor's Annual Manual of the Railways of the United States, we find the following statements relating to the mileage, traffic etc., of railways to the close of the year 1883:

Total mileage, Jan. 1, 1884, 121,592 miles, of which amount 6,753 miles were built in 1883. The average mileage operated in the past year was 110,414. The amount of share capital issued by the several companies up to the end of this fiscal year was $3,708,060,583, an increase of $207,024,759 in the year. The funded debts amounted to $3,455,040,383, an increase of $219,497,060; the floating or unfunded debts from the previous years equalled $332,370,345.

The cost of actual construction per mile has steadily decreased since 1879, but the apparent cost, as represented by share capital and debt, has as steadily increased; the increase of cost in the four years since 1879 as represented by share capital and debt is now $4,446 per mile.

The gross earnings of all the roads for their several fiscal years of 1883 were $823,772,924, an increase of $53,563,025 over 1882.

Of the gross receipts, $215,287,824 were from passengers, $549,756,695 from freight, and $58,728,405 from miscellaneous sources. The net earnings were $336,911,884, an increase of $21,461,082 over 1882. The amount of interest paid was $173,139,064, and the amount of dividends paid was $102,052,548.

The percentage in 1883 of gross earnings to investment was 10.99 per cent.; in 1882, 11.74 per cent. in 1881, 11.18 per cent.; in 1880, 11.36 per cent.; in 1879, 10.80 per cent. The percentage in 1883 of net earnings to investment was

4.49 per cent.; in 1882, 4.81 per cent.; in 1881, 4.56 per cent.; in 1880, 5.04 per cent.; and in 1879, 4.40 per cent. The earnings per mile of all railroads operated in 1883 were, gross $7,548, net $3,051; in 1882, gross, $7,377, net $3,005; in 1881, gross, $7,548, net, $3,078; in 1880, gross, $7,475, net, $3,318; and in 1879, gross, $6,652, net, $2,761.

As an evidence of the immense increase of fictitious railway capital it is noted that the cost of new mileage, for the 3 years ending Dec. 31, 1883, as represented by share capital and indebtedness, is $70,000 per mile; the actual cost certainly did not exceed $30,000 per mile, the difference representing the amount out of which a confiding and deluded public have been swindled by able and unscrupulous manipulators of new railways.

In 1883 400,553,439 tons of freight were moved on all the railways of the United States. This total movement equalled 44,061,923,445 tons moved one mile at an average charge of 1.24 cents per ton per mile.

The number of passengers transported equalled 312,686,641, not including the New York Elevated Railway traffic, a number more than 6 times the total population of the United States. The total movement equalled 8,541,309,674 persons moved one mile at an average charge of 2.42 cents per passenger per mile.

The New Orleans Exposition.

The World's Exposition, opening in New Orleans Dec. 1, 1884, and closing May 31, 1885, promises to be the grandest success of the kind since the Centennial of 1876.

The list of its exhibits embraces everything from agriculture to works of arts, but the industrial will be the main feature in the display. Financially, the resources of the managers are ample to meet all demands. The general government has appropriated $1,300,000, the citizens of New Orleans, $500,000, and the City of New Orleans and the State of Louisiana $100,000 each.

The main building will afford 50 per cent. more space than the main building of the Centennial Exposition at Philadelphia. It is 1,378 ft. long by 905 ft. wide; the United States and State Exhibition Building is 885ft. by 565 ft.; the Horticultural Hall is 600 ft. by 194 ft.; the Art Gallery is 250 ft. by 100 ft.; and the Factories and Mills are in a structure 350 ft. by 120 ft. All of these are distinct buildings, and in area far exceed the original estimate of space required, The additional area being imperaturely demanded by the unexpectedly great increase in applications for space. The exhibition grounds cover 247 acres.

The special features of the Exposition will be numerous and striking, a leading exhibit in this class being the "tropical display," Mexico, Central and South America and the West Indias uniting to make it most complete and comprehensive. The general government exhibit will in magnitude and variety far exceed the magnificent display in Philadelphia in 1876.

The very important question of accommodation for the crowds of visitors expected has been seriously considered, and numerous hotel companies are preparing to establish capacious buildings near the grounds; with these and the numerous hotels, etc., upon the Mississippi Sound Coast and the buildings disposable in the City proper, the management believe that no trouble need be anticipated.

Special rates are being arranged for transportation and excursions from all available points; at figures never before secured.

E. A. Burke is the Director General of the Exposition and any special information can be obtained by addressing him at New Orleans, La.

MESSRS. ROGERS & BALLENTINE have the contract for building the 60 mile branch of the Louisville, New Orleans, and Texas, from Port Allen to Vermillionville, La.

PERSONAL.

JOHN WORK GARRETT, late President of the B. & O. R. R. Co., died at his residence, Deer Park, Baltimore, on the morning of September 26th.

Mr. Garrett was born in Baltimore on July 31, 1820; he was the second son of Robert Garrett, of Baltimore, and Elizabeth Stauffer, of Lancaster, Pa., and after a preparatory education in private schools, graduated at Lafayette College. In 1849 he and his elder brother, Henry S. Garrett, went into parnership with their father in the flourishing banking and commission business established by the latter.

In 1857 Mr. Garrett first became prominently identified with the Baltimore & Ohio R. R. In that year a crisis was reached in the company's affairs, and the house of Robt. Garrett & Son's having been one of the largest subscribers for the extension of the road west of Wheeling, in the panic of 1857, was thought to be over-burdened with the securities of the Baltimore & Ohio; but the storm was weathered and greater interests secured. Up to this time the management of the road had been purely political, the State and the City of Baltimore controlling two-thirds of the stock; but in 1857 Mr. J. W. Garrett was made a member of the directory as a special representative of the private stockholders.

On November 17, 1858, on the nomination of the late Johns Hopkins, Mr. Garrett was made President of the Baltimore & Ohio R. R., succeeding the late Chauncey Brooks, and held that position ever since, depending much however, of late years, upon the assistance of his elder son, Mr. Robert Garrett, first Vice-president. Under the new constitution of 1867 the sale of the States' interest and the reduction of its representation was authorized and the private holders regained control of the road.

Mr. Garrett's administrative qualities were severely tested during the Civil War, when his road became an important factor in the transportation of troops. After the war the road was thoroughly repaired and developed and extended.

More recently Mr. Garrett's name has been prominent in connection with the organization of the express and telegraph companies now forming an important feature of the Baltimore & Ohio R. R. system.

In person Mr. Garrett was large and portly, with strongly marked features, indicative of great will-power and immense capacity of endurance. In the midst of the affairs of his company, he found time to devote to society, literature, art and agriculture, and he took an especial and lively interest in all that related to the welfare of Baltimore. He was one of the trustees of the Johns Hopkins University fund. Mr. Garrett was married in early life to a daughter of Thos. B. Harrison, a well known merchant of Baltimore. He leaves four children, three sons and a daughter.

CHARLES G. DARRACH; late Asst. Engineer in the Philadelphia Water Department, is now connected with the well known firm of Wilson Bros. of Philadelphia, having charge of all hydraulic work. In this capacity MR. DARRACH has designed and is now superintending the erection of the new water supply for the town of Red Bank, New Jersey.

MONTREAL, Sept. 30.—B. W. BIGGS son of a wealthy and eminent engineer of London, who arrived in this city from England in the latter part of June, has been missing since Aug. 18. His friends are in great distress over his disapearance, and have placed the matter in the hands of the police.

A SURVEYING party is at work between the two lines of the Manitoba Railway, north of Herman, Grant County, Minn.

LITERATURE.

The Theory of Deflections and of Latitudes and Departures, with special application to curvilinear surveys for alignments of railway-tracks. By ISAAC W. SMITH, C. E. New York, D. Van Nostrand, 1884.

This latest addition to the already extensive literature of railroad location is a very neatly printed pocket-book of 229 pages and 22 plates, which exhibits a great deal of systematic labor and patience on the part of the author. Engineers who have been educated in the methods of Henck, Shunk, or Searles, will find it difficult to read or use, on account of the new and very elaborate notation for expressing angles and deflections. The necessity of more comprehensive definitions and methods in the discussion of angular quantities has led mathematicians to the sciences of vector analysis and quaternions, and this book is the first we have seen where practical use is made of directions rather than angles. Field engineers who like to see old and well known formulas deduced by a new and systematic, though sometimes tedious method, will find the work suggestive and interesting. Considerable space is devoted to turnouts, sidings and crossings. The formulas for reversed and compound curves are arrayed in tabular forms very neatly. No tables of logarithms are given. The abbreviations B. C. and E. C. are used instead of the usual P. C. and P. T. to denote the beginning and end of a curve. The term "degree of curvature" is used instead of the usual degree of curve. In common with most authors the rude bearings of the magnetic needle are employed to check the accuracy of angles measured by a transit to single minutes. The method of keeping field notes and computations is explained with fullness. We appreciate the ability and energy shown by the author in bringing out a new presentation of the old, but important subject of railroad curves. We have not had the time to thoroughly master the peculiar notation which is so frequently used in the text and on the folding plates, but have no doubt it will prove of advantage to mankind if it tends to simplify or systematise either the theory or practice of curvilinear surveys.

The Electric Headlight.

The locomotive electric headlight, which is an Indianapolis invention, was last week placed upon engine No. 17, of the Cleveland, Akron & Columbus road, and run through to Cleveland, O., creating considerable enthusiasm among the railroad men in northern Ohio. On the train were General Manager Townsend and Master Mechanic Thornbury, of the Cleveland, Lorain & Wheeling road, Charles Latimer, chief engineer, and Mr. Fuller, master mechanic of the New York, Pennsylvania & Ohio road; Sam Briggs, general manager, and Mr. Bean, master mechanic of the Connotton Valley road; N. Monsarrat, general superintendent, and the master mechanic of the Cleveland, Arkon & Columbus road; Superintendent Blee and Master Mechanic Turreff, of the C., C., C. & I. road; Superintendent P. Brunner, of the C. & P.; Superintendent of the Motion Power Stevens, of the Lake Shore; L. Williams, general manager of the Nickel-Plate, and other railroad men. As the train entered the suburbs of Cleveland, every crossing was crowded with wondering people to witness the novel sight, which was loudly cheered as it rushed swiftly by.

The dynamo that furnishes the light is a small affair fastened to the foot-board of the engine, on the left, and directly in front of the cab. It is run by a three-horse-power rotary engine fastened between it and the cab, the steam power being derived from the boiler of the engine. The light is equivalent to that which would be derived from 2,000 candles.

The power necessary to run the dynamo will not exceed one and one-half horse power. The officials of the American Electric Light Company, which was, as well, organized at Indianapolis, are receiving inquiries from all parts of the country regarding the light, and as soon as it is perfected all express a desire to put it in use on their respective roads.

American Society of Civil Engineers.

AT the regular meeting of the Society held on Wednesday evening, the following were elected: Burr K. Field, Supt. of Bridges, Philadelphia, Pa.; Chas. A. Marshall, Engineer of Tests, Cambria, Iron Co., Johnstown, Pa.; Robt. J. Sloan, Chief Engineer, Manhattan Elevated R. R., New York City.

Mr. H. T. Wood of London, Eng., addressed the meeting on the subject of the proposed International Inventors Exhibition to be held in 1885 in London. The objects of the Exhibition were explained and the hope expressed that American manufactures would be liberally represented, The exhibition will open in May; it is essential that space be applied for as early as possible. Mr. Wood had a number of prospectuses for distribution, and information can be obtained by addressing the British Vice-Consul in this city.

A paper by F. P. Stearns, M. Am. Soc. C. E., on "Experiments on the Flow of Water in a 48-inch Pipe," was read by the Secretary.

New England Water Works Association.

The fall meeting of the New England Water Works Association, was held at Newton, Mass., on Wednesday September 24th. Members and guests to the number of about 125, met at the City Hall at 10 o'clock, and after having been welcomed by the President of the Water Board, were taken in barges to the Newton pumping station and filter basin, and also to the Boston aqueduct bridge over Charles River.

After a lunch at the Woodland Park hotel, a short business meeting of the Association was held in the hotel parlor, and Mr. R. C. P. Coggeshall, Superintendent of the New Bedford Water Works and former Secretary of the Association, was presented with a gold headed cane and a large steel engraving. The party next visited some of the engine houses of the fire department, and an alarm of fire was given to exhibit the working of the department. After a very satisfactory exhibition the barges were again taken and visits made to the Waban Hill reservoir of the Newton Works, and the Chestnut Hill reservoir of the Boston Works. The party then proceeded to Boston, stopping on the way to inspect the raising of a 40 inch water main. The meeting was brought to a close with a complimentary dinner, at the Hotel Vendome given to the Association by the citizens of Newton.

After dinner speeches were made by Edward W. Cate, President of the Newton Water Board; Major Kimball, of Newton; Major Cummings, of Somerville; G. A. Ellis, of Springfield, President of the New England Water-works Association; Col. Haggett, President of the Lowell Water Board; President Kingsley of the Cambridge Water Board, and others.

The members and guests present embraced among their numbers water-works superintendents and officials from Springfield, Worcester, Fitchburg, Cambridge, Somerville, New Bedford. Taunton, and Lawrence, Mass., Manchester, N. H., Lewiston, Maine, Providence, R. I., Norwich, Conn., and other New England cities and towns.

IT is reported that George Harding will build a cable road from Palenville to his summer resort, the Hotel Kaaterskill.

TRACK.*

BY W. B. PARSONS, JR., C. E.
ROADMASTER N. Y. AND GREENWOOD LAKE DIV., ERIE R. R.

Section Lengths.—The proper length of a section depends upon several conditions; amount of traffic, kind of ballast, condition of road-bed, amount of outside work, such as switches, etc., and excellence of track expected. For a single track, lengths ordinarily vary from four to seven miles with extreme cases on very poor lines of eight and ten; but four and a half or five miles can be adopted as a fair standard for average conditions.

On double track lengths vary from three to five miles, with three and a half or four as equivalent to five on single track.

The amount of work is not quite twice as great on a double line. Ditching, cleaning up, cutting grass, and such work are about the same in either case; while the double line operates in favor of the men in the fact that they always know from which direction to look for trains, and can do their work and run their handcar or grampus with corresponding impunity. The question of force required, depends on the same conditions coupled with the locality and season. One man per mile of single track is a good rule to follow, and to increase the force when occasion demands, such as heavy snow in winter or when ties are being put in the spring. Where large yards occur either the section limit must be reduced or force increased, or both, while if a yard is very large it is then best to have several gangs in charge of assistant foremen who report to one general foreman. To this section force is to be added one trackwalker who should walk the section at least once a day. During the summer, if no wash-outs or other danger is to be apprehended, he can safely be allowed, having walked the track and performed his regular duties in the forenoon, to join the gang in the afternoon. But in the winter, spring, dry seasons, and at all times when danger is feared, he should be kept constantly patrolling his section, and at these times mentioned at least, if not all the time, a night walker should also be put on. If there are particular spots of danger such as sliding banks, cuts through loose rock, etc., special watchmen should be detailed to these places. Too much care cannot be given to safely guarding the track.

The day trackwalker should be provided with a wrench, a light hammer having one end edge pointed, and a flag. Beside merely walking over the track he should tighten loose bolts, drive down spikes that are working up, and carefully examine on each trip each bridge to detect any chance of fire and also all switch connections and frogs. During warm weather, if the switches are of the "stubb" pattern, he should throw them each day and if found tight should so report. In winter he should keep snow and ice from packing hard about switches, frogs, guard rails, and crossings. In fact, the position of trackwalker is one of more than ordinary importance and should be entrusted to a careful and reliable man. The night trackwalker is expected only to walk the section and see that everything is safe. He should be provided with a lantern and torpedoes. As a rule the times of starting on their trips can be so arranged as to have the trackwalkers cover their sections immediately in advance of the principal trains.

Tools.—Each section force should have a full complement of good tools, enough to supply every man in the gang, and also some in addition, of those kinds that need occasionally to be sent to shop for repairs or dressing. Besides this, there should be kept on hand at headquarters an extra stock in order to be able to equip a sudden necessary increase of force at time of flood, washout, wreck, or similar emergency. For a gang of foreman, two trackwalkers and six men, the following list will be sufficient for all ordinary cases.

LIST OF TOOLS.

Hammers: 4 spiking mauls, 6 ballast hammers,* 1 nail hammer, 2 sledges, 1 trackwalker's hammer.

Bars: 8 tamping bars, 3 lining bars, 3 pinch bars, 1 heavy pinch-bar, 3 claw bars.

Picks; 8 common picks, 6 tamping picks, 3 grub hoes.

Shovels: 1 long handled shovel, 6 common shovels, 6 scoops.

Axes: 1 common axe, 2 adzes, 2 hand axes or hatchets.

Wrenches: 6 track wrenches, 1 trackwalker's wrench, 1 monkey wrench.

Signals: 4 red flags, 5 white lanterns, 2 red lanterns, 8 torpedoes.

Miscellaneous.—1 hand car, 1 grampus or push car, 2 track gauges, 3 rail tongs, 12 chisels, 1 hand saw, 1 cross-cut saw, 1 bush hook, 6 scythes and snaths, 1 ratchet drill and 3 bits, (1 inch), 1 brace and 2 bits (¾ inch), 1 water pail and dipper, 1 tape line (50 feet), 1 large oil can, 1 oiler, 1 spirit level, 1 level board, 2 brooms, 3 wheelbarrows, 1 grindstone, 2 tubs, 3 whitewash brushes.

Tools marked * are needed only with stone ballast. If there is a section where rocks are liable to fall it should be equipped with tools to facilitate their removal, consisting of rock drills, stone wedges, blasting powder and fuse.

Also if there are special watchmen to guard dangerous rock cuts, sliding banks, or the like, each man should be furnished with: 1 wheelbarrow, 1 pick, 1 shovel, 1 ballast hammer, 2 flags, 6 torpedoes. Beside these section tools named there should be kept on hand at the supervisor's or road-master's headquarters, 1 rail bender or "jim-crow," and large track levers, at least 1 for every three sections.

TO BE CONTINUED.

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Project for an Elevated Railway in Paris.

The last number of *Le Genie Civil* contains a project, by Jules Garnier, for an elevated railway for Paris. This subject has been agitated since 1871, and the elevated *vs.* the subterranean system discussed in all their bearings. In August, 1883, the French Society of Civil Engineers decided against the underground system, but the elevated road was still strongly objected to as likely to obstruct travel upon and mar the beauty of the magnificent avenues of Paris.

M. Garnier now presents a scheme which he believes will reduce to a minimum the objectionable features. He proposes a double track, elevated railway, with one track located above the other. His supporting piers or columns occupy the middle of the street, and have a minimum height of 15 ft above the pavement; they are spaced about 131 ft. apart

Two trusses of a simple lattice form carry the two tracks, one through the truss and the other on the deck. The tracks are 5 ft, gauge, and they are 10 ft. 8 in. apart vertically. At the terminal stations trains are to be transferred from one track to the other by a pivoted tilting transfer platform 230 ft. long.

Whenever possible masonry is to be substituted for the metallic viaduct, and when iron is used a close floor will be put under the lower track.

The rolling stock is modeled after the American practice; cars 46 ft. by 7 ft. wide, with longitudinal seats on the sides and a central passage with end doors. Each train is to have 3 cars and each car carry 60 persons. Fireless locomotives are suggested, to be run by superheated steam, compressed air or electricity.

To obviate the danger at grade crossings—overhead crossings being impossible—trains on intersecting lines do not cross at all, but by a curve range up alongside of the other line, transfer the passengers and then return on the upper or lower track of the same line, as the case may be. This requires special depots at such points.

The stations will be from 1640 to 2624 ft. apart. The line as located is in all 17½ miles long, and the cost is estimated at $9.000.000 or about $51.430 per mile.

The rate charged is to be uniform, at 25 centimes (4.65 cts.) and 10 centimes (1.86 cts) for workingmen's trains,

Cork as a Building Material.

BY W. WAGNER.

In this Paper the Author points out the advantages to be derived from the use of cork for building purposes, and describes a brick produced by a firm in Ludwigshafen, of which this material forms one of the chief ingredients. The shape in which the cork is utilized is a kind of concrete which is afterwards formed into bricks. The cork employed consists of chips reduced by machinery to the size of peas. The matrix used for producing coherence between the particles of the aggregate is composed of lime and clay. After the concrete has been prepared it is pressed into the required sized bricks, which are baked in kilns at a temperature of 120° to 150° Centigrade (248° to 302° Fahrenheit,) the result being an extremely porous stone of very low specific gravity. Bricks produced in this manner, and of the same form and dimensions as the German normal brick (9.8 inches × 4.7 inches × 2.5 inches,) weigh only 600 grams (1.3 lb.,) with a specific gravity of 0.3 (specific gravity of cork 0.24.) The mean compressive strain they are capable of withstanding is 2.8 kilograms per square centimetre (40 lbs. per square inch.) A German normal brick weighs from 8.4 to 8.8 lbs., and possesses a resistance against crushing varying from 4 to 7 kilograms per square centimetre (57 to 100 lbs. per square inches.) Cork stone is a very indifferent conductor of heat, and is capable of withstanding a temperature of 180° Centigrade (356° Fahrenheit.) The chief advantages of the material are its small weight, capacity for being moulded into bricks of every form and size, that the bricks can be readily cut or sawn, and will take nails and screws, and form a good surface for plastering as well as resist great heat. On account of these qualities it is remarkably well adapted for damp-roof courses, lining buildings to neutralise effects of temperature, forming unsupported walls in upper stories, etc. —(*From "Abstracts etc." Inst. Civ Eng's.*)

The Hardening of Cement.

Herr Frühling, in a communication to one of the German technical societies, says the *Mechanical World*, makes some important comparisons between the rate of hardening of hydraulic cements, and upon the nature of this process. According to this investigator, a Portland cement (which requires from 12 to 15 hours to set) will, inside of three days, have acquired a greater hardness than the far more quick-setting Roman cement (which requires only from 5 to 15 minutes to set). He makes the further assertion that, while the hardening process with the quick setting Roman cement continues for many months, or even years, this process with a genuine Portland is substantially completed within the first 15 days, for the amount of increase in hardness which takes plaace thereafter, he affirms, is quite insignificant in comparison with the figures representing the hardening of the first 15 days. In this statement Frühling is not in accord with all writers on the subject, who are unanimous on the point that Portland cement continues notably in hardness and tenacity for the period of a year, or even considerably longer. He discards also the generally accepted explanation that the hardening of cement depend on the formation of silicates. He considers a hardened cement to possess, both chemically and physically, the properties of a dense hydrate of lime. He bases these statements on the following facts: The natural hydrated silicates of lime do not excercise any decomposing action on solutions of ammonium salts—the chloride, or sulphate for example—while, as a rule, the entire quantity of lime in a cement, whether it be derived from a Portland or a Roman cement, will act upon the above-named ammonium salts, precisely like hydrated lime to decompose them. He argues that in the production of a cement the rule should be followed not to endeavor to introduce the largest possible quantity of silicic acid, but the largest quantity of lime. If the proper limit is overstepped, so that, for instance, 3 or 4 per cent. more silicic acid is introduced than experience has shown to be sufficient, the result is not a better hardening cement, but, on the contrary, one that is almost worthless. The formation of a hydrate of lime, according to Frühling, is the basis of the binding quality of the cements; and, in comparison with lime, he claims that silicic acid and alumina play a very subordinate *role*.

Self Registering Rain-Gauge.

The self registering rain gauge (of A. Frank) is made on the principle of weighing the rain water, and consists of two parts, the weighing apparatus and the registering apparatus.

From the receiving vessel the rain water flows to the collecting vessel, which, to prevent evaporation, has the smallest possible opening at the top and is provided with a tap at the bottom to run the water off. A later improvement is to run the water off by a syphon and then let the receiver be self-acting. The collecting vessel hangs on two wires, which pass over two pairs of pulleys, and are attached to the last of them. To these is fastened a lever, at the end of which by a hinge hangs a weight. As the weight of water in the collecting vessel increases, the length of the horizontal arm of the weight increases, so as to maintain equilibrium, the increase in the length of the arm being proportional to the increase in the weight of the water. The length of the horizontal arm, which is thus a measure of the amount or rain is brought to paper as follows:

The weight is so hung that it is always vertical and keeps in a vertical position a light rod which slips through it, and at the end of which is a pencil which records on a strip of paper, passing under it by a clockwork at a fixed rate of speed, the length of the horizontal bar. In this way a diagram is made on the paper, the abscissas being proportional to the time and it ordinates to the rainfall.

The weight of the collecting vessel and of the lever are counter balanced by weights and to diminish friction, all the axles work upon steel points. The machine will not register snow.—(Abstracts Institution C. E.)

WATER.

KALAMAZOO, MICH., has twenty miles of water mains.

THE Oshkosh, Wis., water-works are completed.

ATLANTA is sinking an artesian well for additional water supply.

WISNER, NEB., is to have water-works, the contract price of which is $4,328.

CLEVELAND, O. will invest $50,000 in a fire tug, 5 new engines and a chemical extinguisher. Larger water mains will also be laid in certain parts of the city.

IT is charged that water has been transferred from a filthy creek into the open reservoir of the Galesburg Ill., Water-works Company. The water smells badly.

A DENVER company has been organized to ship artesian water to Cheyenne by the tankful. The plan is to send a tank, holding 10,000 gallons, up each night and distribute it by wagon tanks around the city.

A SHENANDOAH (PA.) dispatch says: "Water is becoming very scarce here. At nearly all the collieries in this region the water must be hauled for a number of miles, but it is feared some collieries will have to stop if relief does not soon come.

CHIEF ENGINEER CHURCH, reported last week, to the Aqueduct Commission, that the first section of the new Aqueduct would extend from High Bridge to the Claflin Estate, a distance of 11,850 ft. and would cost $1,343,000.

Commissioner Thompson advocated the retention by the Commissioners of absolute control over certain features of the work, and that the engineers should not change the size and grade of the aqueduct without theconsent and approval of the Commission.

FRAMINGHAM, MASS., is suffering badly from impure water supply, one-half of the people there drinking water from contaminated wells, in which lurk the germs of fever and kindred diseases. The demand is for a regular and well established system of water supply and works.

WATER is 25 cents per barrel and milk 50 cents per gallon in Lordsburg, N. M.

THE City of Syracuse, N. Y., is considering the purchase of the water-works owned by the Syracuse Water Company, and a commission is to be appointed by the Supreme Court to appraise the value of the works. There are about fifty miles of distribution-pipe in the city.

LANESBORO, MINN., is constructing a system of water-works. The water is obtained by boring a hill 350 feet in height that almost divides the city. At a depth of 207 feet, 46 feet of water was obtained, which will be elevated by a wind-wheel to a reservoir, from which it will be distributed throughout the city.

THE reservoir for the Biddeford, Me., water-works is completed. It is 200 feet above tide water, 35 feet deep and 900 feet in circumference. Thomas Shahan of Portland, Me., was the contractor. Pipes are being laid by Ephraim Dyer of Standish.

THE City of Durango, Col., has contracted with the Curtis Regulator Co. of Boston for a street main 10 in. pressure regulator to reduce their reservoir pressure of 160 lbs., to 80 or 100 lbs, as may be desired. The regulator is so constructed that fire pressure may be instantly put on as well.

CORRECTION.

PROVIDENCE, SEPT. 26, 1884.

EDITOR OF ENGINEERING NEWS.—In the copy of my formula that you published in your last issue, you called V the velocity in the 2½ inch hose. It should be V = velocity of efflux as in the original paper.

EDMUND B. WESTON.

MUNICIPAL INDEBTEDNESS—WATER SUPPLY.—A constitutional provision limiting the indebtedness of cities to 2 per cent. was held by the Supreme Court of Indiana not to apply to contracts for a period of years for water to be paid for as the water was furnished at so much rent per annum, where it was shown that the contract price could be paid from the current resources, according as the water was furnished, and without increasing the corporate indebtedness beyond the constitutional limit. The court said that the supply of water constituted one of the items of current expenditure essential to the welfare of the corporation. The City of Valparaiso et al. vs. Gardner, decided September 16.

AT the meeting of the Aqueduct Commissioners Wednesday, the Commissioner of Public Works submitted plans of specifications, forms of contracts and bonds for the new aqueduct in the Twenty-fourth ward. They were approved by the Commissioners and by Corporation Counsel Lacombe. It was ordered that advertisements be prepared for bids on this portion of the work. The new aqueduct extends five miles within the city limits. Mayor Edson said there was no reason why work on the aqueduct could not be begun in forty days

NEWS OF THE WEEK.

Railroads and Canals.

ON September 30th the Union Pacific opened its high line on the South Park Division from Breckenridge to Headville.

A CONTRACT has, we are informed, very lately been entered into for the supply of 220,000 iron sleepers to the Baden railway system.

THE contract for the extension of the Brooklyn Bridge over Chatham St. is held by the Phœnix Bridge Company for $30,000, to be completed within 90 days.

THE engineer corps of the Illinois Southern & Paducah railroad, in re-locating the route between Murfreesboro and East St. Louis, propose to run the line via Ora, Ava, Evansville and Red Bud.

THE Nashville & Florence road is now completed to Loretta, Tenn., fifteen miles southward from the late terminus at Lawrenceburg, and fifty miles from the junction with the Louisville & Nashville near Columbia. The road-bed is nearly all graded for the seven miles from Loretta south to the Alabama line.

PRESIDENT NUTT, of the St. Louis & San Francisco Railway, says that it is proposed to build 100 miles of road west from Red Fork, in the Indian Territory, this winter, and that it was probable that fifty miles of road east from Albuquerque would be built before spring.

J. P. MCDONALD, contractor, finished surfacing the last mile of track on the Louisville, New Orleans and Texas main line Sept. 26. The contracts have been awarded for work on the Greenville branch.

W. J. WRIGHT of Birmingham, Ala. has the contract for a new Georgia 3 ft. gauge railroad, on which work was commenced Sept. 22d. Wright Bros., & Co. are also contractors for the Americus, Preston and —— R. R. Narrow gauge, also a Georgia R. R.

A street railway is projected at Olympia, Washington Territory.

THE survey of the Sioux Falls, Fairbank and Western Railroad, whose incorporation was noticed in the last number of this journal, has commenced under Chief Engineer W. W. Walker of Cedar Rapids.

READING, Pa., Sept. 25.—The Pennsylvania Schuykill Valley Railroad was formally opened this morning between Pottstown and Philadelphia. Surveyors are now working on the proposed Reading & Lebanon road, from here to Harrisburg.

THE Florida Southern Railway is receiving bids for the construction of its line from Leesburg to Pemberton's Ferry, thirty miles from Leesburg, on the Withlacoochee River. The contractors will be required to give bonds for its completion, ready for the cars within five months.

ON September 25th, President Zimmerman obtained a charter for his road from Nashville to a point south of Scottsville, Ky., where it connects with the Chesapeake and Nashville, chartered under the laws of Kentucky as the Cincinnati, Green River and Nashville Railroad. The engineers are now proceeding with the preliminary survey and location.

THE Lake Megantic Railroad Company are again trying to procure a feasible route across Moose Head Lake. W. Nickerson, C. E., of Orrington, has been sent to the lake by the company and he will survey a line across the lake near Deer Island, which is about ten miles from Greenville. At this point both Deer and Sugar Islands could be crossed, thus leaving only about two miles of bridging.

INDIANAPOLIS, Ind. Sept. 25.—The Salem, Madison and Cincinnati Railroad company was incorporated to-day under the State law. The company's capital stock is placed at $5,000,000. The road is designed to connect Salem and Cincinnati. The distance is 120 miles. The same parties are named also as directors of the Orleans, French Lick, West Baden and Jasper Railroad company, incorporated to-day. The capital stock is $2,000,000 divided into forty thousand shares, and the line will be 44 miles in length.

BROOKLYN RAPID TRANSIT NOTES.—The Nassau Cable Road has gotten as far as a hearing before Commissioners. The Brooklyn and Coney Island Cable Road has obtained its franchise and will get to work immediately. The Brooklyn Elevated has completed its superstructure to Broadway, and is advancing at the rate of 250 feet a day. Locomotives will be used as motive power. The Kings County Elevated is still in check by Commissioner Fleeman, and is doing nothing apparently.

IT is reported that Mr. Collingwood Schrieber, engineer of Dominion Government Railways, has condemned much of the work on the Canadian Pacific lines between British Columbia and Winnipeg, the grades in many places exceeding the maximum allowable. The report further has it that it is almost impossible to hold a train on some portions of the line, and that runaway trains are of almost daily occurrence. To allay the danger flying switches have been put in, so that when a train gets beyond the control of the engineer it can be switched off the main line to a siding with an upward inline. This defect is likely to cause serious complications between the Dominion Government and the company.

Some years ago there was a section of railroad tract completed but not operated between Fredericksburg, Va., and a way station a few miles distant. In order to utilize the track for the time being a man who owned a small stationary engine mounted it on a flat car, made a crank connection with the wheels, and with a molasses hogshead for a water tank run up and down the track for freight and passengers. One of those indefatigable geniuses peculiar to the wilderness of Spottsylvania, becoming disgusted with the tardy movements of the railroad company, and fearing that his hoop-poles, if kept much longer on hand, would not be merchantable, conceived the novel idea of hauling them to town on a flat car drawn by a young bull. The car was loaded with 100 bundles of poles. There was some difficulty at first in teaching the bull exactly what was expected of him. The modus operandi was as follows: The bull drew the car up the grades and was then unhitched and mounted on a platform at the rear of the car, which then ran down grade without help. As soon as his bullship got the hang of the thing he took to it very kindly, dragging the car up the grades with great alacrity, and evincing the same pleasure in riding down that is shown by boys who drag their sleds up-hill for the pleasure of sliding down again.—*Cleveland Herald.*

ROCHESTER, N. Y., Sept. 19.—Preliminary surveys have been started for a railroad running between Rochester and Hemlock Lake. The company was organized some years ago and incorporated as the Rochester & Southern Railroad Company. Its capital stock is $300,000. The road will be narrow gauge. Valuable grants have been given by the State.

AN interesting map is now being prepared at Mr. Stanford's for the Duke of Sutherland, on which is shown in great elaboration the configuration of the country through which it is proposed to form a ship canal from Mount Carmel to the Red Sea. This map is mainly based on the surveys by Prof. Hull and Col. Colville, and will exhibit lines of equal altitude at intervals of 200 ft. of absolute height. From the map when completed it is proposed to construct a model in relief which will be enclosed in sides of plate glass up to the level of the highest mountain peak, and made water tight. Water will then be introduced, and, being drawn off by taps till the level of the Mediterranean is reached, it will be at once apparent what will be the magnitude of the great inland sea extending from the waters of Merom to the desert of Arabia Petræa, which would be formed by letting the Mediterranean flow into the valley of the Jordan.

THE following from a Guatemala correspondent of the New Orleans *Times-Democrat* throws some light on Central American methods of railway building. "I have been over to Puerto Barrios and San Tomas since my last, and can say something of the progress of the work on the railroad there. It is not going on at railroad speed, in fact it looks like boys' play. In little bits here and there is about a mile and a half of grading done, a small wharf has been constructed at Puerto Barrios out to about four feet of water, an engine of about thirty tons' weight is on stilts under a shed of palm leaves, and some dump-cars are dumped along ahead of it, some in the ditch and some on rails; a passenger station, or the lumber for one, is neatly piled upon one side, and 400 tons of steel rails are in two piles upon either side of the locomotive; one pile of rails has a cross-section half an inch higher than the other, which I suppose is intentional, the same as the plowman's short leg with which he was born 'at his own particular request, so that he could plow on the side hill.'

The Chief Engineer, Col. Miller, came down from Guatemala the other day, expecting to find two miles of track or two miles of grading or something done which he could estimate and turn in to the credit of the contractors, but it failed to materialize, and he appears to be waiting developments."

In speaking of the development of railroads in China, a traveler said to a New York *Tribune* reporter:

"There is a railroad! That is a new thing for China if you please! You remember that some six years ago, some Englishmen organized the Kaiping Railway Company, for the purpose of building a road to the Kaiping mines from Tientsin. It created a vast deal of talk then, and the reports have been as few as the dividends. But that road is building. A thousand Chinese are at work under direction of C. W. Kinder, who, with the Secretary B. M. Brown, gave me many courtesies. They at first got reluctant permission to build seven miles of road, and the ground had to be laid out five times before land could be procured and graves in the way removed. The ground was level, and happily required little grading. Men came to work as soon as the seven superstitious miles were completed, and the entire distance will be covered within a year, if nothing happens. The road has three ordinary cars brought from England, fifty coal trucks and an elegant coach, designed for the higher officials. There are three locomotives, one of them the first built in China. It was made in Kaiping, and is named the Rocket of China. The other two were imported. From Lutan to Showkuchong six round trips are made daily. Passage is 7 cents, and passenger travel pays the train's running expenses. The daily freight averages 200 tons, mostly of coal. The engineers are Englishmen, but the stokers, conductors and brakemen are all Chinese The mines support the road.

ELKTON, Md. Sept. 15.—Section 12 of the new Baltimore and Ohio Railroad, in this vicinity, is almost ready for the track and iron bridges, and is one of the heaviest on the whole line, Owing to the push and vim of Shields & Dorwin, who have the contract for grading, and Savage & Leavitt, for the masonry, the section will be about the first completed on the line. The masonry is now ready for the ironwork. The powerful steam shovel at work here is working in a cut 54 ft. deep and 2,000 ft. long. A great portion of the cut is through solid rock, where dynamite blasting is required. A large number of springs have been encountered while making the excavations, and it is a difficult job to handle and move the shovel, the mud getting so deep that plank floors are required for the men to work upon. This cut required the removal of 100,000 cubic yards of earth and stone. There is another large cut in this section which is 50 ft. deep, and the earth taken from here is being used to make a fill or embankment across the Little Elk creek, which will be 60 ft. high and 200 ft. wide at the base, and when completed will contain over 100,000 cubic yards of earth. There is a great deal of masonry on this section. At Laurel Run the contractors have just completed an arch 20 ft. wide and 160 ft. long, most of the stone having been taken from quarries opened near the work, but most of the other structures are built of Port Deposit granite. Where the line crosses the northeast road two U abutments have been built which are over 30 ft. high. At the Blue Ball road crossing there are two wing abutments 43 ft. high and 160 ft. wide. About 100 ft. from these is the west abutment of the Little Elk bridge. On the other side of the creek is the largest abutment of the kind on the road, it being 60 ft. high and having a front of 200 ft. built, of Port Deposit granite. It has 33 steps on each side. In this structure there are over 5,000 cubic yards of masonry, and these two structures are to support the double-track span iron deck bridge 164 ft. long over the Little Elk creek. About 200 ft. from this point is another large arch over the mill-race at Mackall's mill. Messrs. Savage & Leavitt have been a little over four months at this work, and are now just completing the finishing touches. J. S. Sillyman is the resident engineer, and B. B. Thornton, inspector of masonry.

Miscellaneous.

P. F. BRENNAN has been awarded contract for sewer building at Ansonia, Ct.

THE Chesapeake and Ohio canal is practically useless on account of low water.

THE Keystone Bridge Company are doing the iron work on the Susquehanna bridge of the Baltimore and Ohio.

THE Minneapolis and St. Paul Elevated Railway Company are considering a proposition to run the trains by electricity.

THE State Engineer is pushing the survey of the proposed canal between Peconic and Shinnecock bays in New York State. Contracts for the work will be awarded Oct. 9.

THE new bridge of the New York, New Haven & Hartford Railroad Company, over the Housatonic River, will be finished Nov. 1st. It will be 1,105 feet long, with five spans, a draw of 200 feet.

FIVE sets of plans have been submitted in the competition for the privilege of building the Hall of Records for Brooklyn, N. Y. The limit fixed was $250,000. The lowest estimate is $237,000, the highest $250,000.

THE contract for building the new County bridge over the Little Arlington River, near Jacksonville, Fla., has been let by the County Commissioners of Duval County to J. Francis LeBaron, Civil Engineer, of Jacksonville, for $21,650.

THE Lehigh Valley road will extend its line westward from Ashland to a point on the Allegheny River, where it will connect with the Pittsburgh and Western Railroad, thus forming another through line to the West.

GEO. HARDING, owner of the Hotel Kaaterskill, has completed arrangements for building a cable road up the Catskill Mountains, from Palenville to his hotel. It is to be opened for the season of 1885.

THE field work of the Mississippi River survey under the direction of the Mississippi River Commission has been resumed. A large party under the direction of United Assistant Engineer, O. M. Winchell, consisting of eleven assistants and recorders, and about fifty men, have just begun work near New Madrid. There now remains about fifty miles to complete the topographical and hydrographical survey of the river below Cairo. When that is finished, similar surveys above Cairo will be taken up.

Six observation or guaging parties have also taken the field. They are stationed at the following points viz: New Madrid, Helena, Aakansas City, Vicksburg, Red River Landing and Carrollton. They are to measure daily, the discharge of the river, making use of the current metre and electrical recording apparatus. It is expected that the latter will remain in the field until the floods have passed.

THE increase in the population of Paris since 1876 has been 251,122. The total population is now 2,239,928. In 1876 the total was 1,988,806.

THE Russian Government is said to have determined upon constructing the remaining 137 miles of the Transcaspian Railway to Askabad. The rails have been ordered to be shipped at once from a southern manufactory down the Volga and across the Caspian.

THE contract for dredging the Schuykill River, between Girard Point and Point Breeze, with the view of widening the channel, was awarded by the United States Government to the Kalmont Dredging Company, of Wilmington, at twenty-eight cents per cubic yard. There are 75,000 cubic yards of mud and gravel to be removed.

JUDGE LAWRENCE, in Supreme Court, Chambers, has granted a peremptory mandamus requiring the Commissioner of Public Works and the Commissioners of Parks to give permission to the trustees of the New York and Brooklyn Bridge to make the necessary excavations in Chatham and Centre Streets to erect the structure proposed for the terminus of the bridge.

ON September 25th, 2,610 ft. of the pile trestle bridge, across Lake Pontchartrain, was destroyed by fire. This trestle is on the northeastern road of the Erlanger Syndicate, and formed part of a pile trestle 28 miles long, the longest structure of the kind in the world. It is built entirely of creosoted timber, some of the piles being 80 ft. long. It cost $1,250,000, and was constructed in 1882-83 by Fletcher, Weisenberg & Co., of Cincinnati.

THE following are the bids for furnishing the rip-rap granite for extending the eastern breakwater of Stonington harbor, Conn.; W. B. Chapman, Brooklyn, N. Y., $1.45 per ton; C. W. Parker and Isaac A. Sylvester, Boston, Mass., $1.37 per ton; Charles F. Stoll, New London, Conn., $1.35 per ton; C. T. Derry and James Burns, Boston, Mass., $1.23 per ton; James Scully, Groton, Conn., $1.15 per ton; John A. Banker, New York city, $1.15 per ton. The bids of Scully and Banker, being the same, they have been referred to the Department for decision.

THE Clayton Air Compressor Works, located near the Brooklyn Bridge, Brooklyn, N. Y., have lately shipped several car loads of mining and tunneling machinery, to the West, comprising the Clayton Improved Duplex Air Compressors, rock drills, duplex water pumps for mining drainage, steam boilers, pipe, drill steel, etc. Among the mines which have recently added the Clayton Air Compressors to their plants, are the Big Bend Tunnel and Mining Co., and the Fresno Enterprise Co. of California, and the Copper Queen Mining Co., and the Tombstone Mining and Milling Co. of Arizona. Anumber of orders for large size compressors are booked, and business prospects for this fall are reported as excellent.

A NEW form of paving has been in use in Berlin since last year, which seems to offer some advantages over wood. Layers of bricks are put down and impregnated with asphalt. After a short period they lose any air and water that they may contain, and absorb from 15 to 20 per cent. of the bituminous matter, becoming remarkably elastic, and capable of resisting pressure and damp. The traffic in the Berlin main thoroughfares is of a heavy character, and it has been found that the new paving lasts much longer than any of the other systems, added to which it offers a sure foothold to horses. Occasionally it is found that after three months' wear some of the bricks crumble into dust, but this is believed to arise from a faulty impregnation with asphalt, and not from any real defect in the system.

A NOVEL TUNNELING CONTRIVANCE.—A mammoth hydraulic shield is being used in a sewer at Buffalo, N. Y., for the purpose of tunneling through a bed of sand which has been encountered. It consists of a circular steel plate 11 ft. in diameter and 7 ft. in length, inclosing 36 staves, front and rear, every alternate stave being hollowed out so as to admit a ram. The shield is driven forward by 18 hydraulic rams, the length of thrust being 25 inches. This allows the laying of three bricks. The sewer is constructed inside the shield, and about 900 ft, are to be built in this manner. The invention was perfected by John B. Benedict, of Cincinnati, who superintends its management in Buffalo. It has also been successfully used by him in his native city. The shield weighs 12,000 pounds, and was manufacfactured by Mackintosh, Hemphill & Co., of Pittsburgh, Pa. Its entire weight, including rams, is 8 tons.

THE Lakeside and Lacour levees on Old River, Pointe Coupee parish, have been completed and final settlement made with the contractor, Mr. S. L. James. The line of levee contains 14,646 cubic yards of earthwork and cost $3,140.53.

THE following were the bids for work on the new St. Paul, Minn. Court House, as opened by the Court House Commissioners: Charles and Henry Lauer, $104,800, if Kasota stone was used, and $101,800 if Bayfield stone was selected as the material for the stone work; George J. Grant, $128,000; T. Reardon, $105,000; Breen & Young, $84,236; Michael O'Brien, $126,495; Thomas Grace, $92,524; Alphonsus Girard, $130,297.25. The successful bidders were Messrs Breen & Young. The work is to be completed to the "water table" by September 1, 1885.

A SYNDICATE has been formed for testing and perfecting a new process of manufacturing steel, which is to compete with the Bessemer process.

Jas. Henderson, of Bellefonte, Pa., is the patentee, and united with him in the syndicate are, Mr. C. G. Francklyn, of New York, Marshall Bros., and Hughes & Patterson of Philadelphia, the Reading Iron Works, Montour Iron Works and others. The Henderson is an "open hearth" steel, and is said to be more pliable and easily worked than Bessemer.

THE following proposals were opened the 5th day of September, 1884, by Major A. Mackenzie, Corps of Engineers, U. S. A., for furnishing 10,000 cub. yds. of Rip-Rap on board Government barges in the Mississippi River, between Reed's Landing and Winona, Minn.:

W. Patt and A. Fuster of Alma, Wis., 71½ cts.; Winona Stone & Lime Co., 65 cts.; S. J. Truax, Hastings, 84½ cts.; John Harry, Alma, Wis., 71½ cts.; Chase & Underwood, Minneapolis, Minn., 95 cts. Also the following for furnishing 10,000 cub. yds. of Rip-Rap on board Government barges in the Mississippi River between St. Paul and Hastings, Minn.:

S. J. Truax, Hastings, 74½ cts.; S. W. Chase and F. M. Underwood, Minneapolis, Minn., 74 cts.; A. H. Truax, Hastings, 69 cts.

GEORGIA'S NEW STATE CAPITOL.—ATLANTA, Sept. 26. The contract for the building of the State Capitol of Georgia was to-day awarded to Miles & Horn, of Toledo, O., at $862,756.75, the bond being $172,351.37. The Commission had before them bidders for the supply of stone from half a dozen States, and the oolitic stone of the Salem Lime and Stone Company, of Louisville, Ky., quarried at Salem, Ind., was selected by the Commission, and the contract was accordingly given to Mr. John L. Wheat, Secretary, who was present. The contract calls for $60,000 worth of material. The work will begin immediately. While the Commission is allowed five years in which to build, they are not disposed to wait that long.

THE following levees were let out at Greenville, Monday, Sept. 15, by the Mississippi Levee Board: New Hope levee, Bolivar Count , 30,083 cubic yards, at 20 cents per yard, to Pat Lamb, contractor; Lake Vermilion levee, 30,000 cubic yards, at 20 cents per cubic yard, to Frank Biggins, contractor; Longwood levee, 107,489 cubic yards, at 18 cents per cubic yard, to Duffin Bros., contractors; Robertsonville levee, 85,147 cubic yards, at 23 cents per cubic yard, to Foley & Co., contractors; Brunswick levee, 105,859 cubic yards, at 19¼ cents per cubic yard, to W. O. Flynn, contractor; Hays levee, 1,773 cubic yards, at 16½ cents per cubic yard, to J. D. Cannon, contractor.

THE LARGEST DOCK IN THE WORLD—MILWAUKEE, Sept. 24.—Sealed proposals were opened at the general offices of the Milwaukee, Lake Shore and Western Railway Company, in this city, this afternoon, for the construction of the company's ore docks at Ashland. The work will be one of great magnitude, the estimated cost of the dock being in the neighborhood of $600,000. The plans and specifications of the structure show that it will not only be the largest on the lakes, but the largest ore dock in the world. Its extreme length over all will be 1,400 feet, and it will be 46 feet wide and 40 feet high. There will be 234 pockets, with a capacity of 25,000 tons of ore; two train loads of ore can be dumped at the same time, and the largest vessels can be loaded in from six to eight hours. The superstructure will rest upon 7,000 piles, forming a dock basin which will be filled solid from the bottom of the harbor to 19 inches above high water mark. The dock will draw 20 feet of water, so that the largest vessel afloat upon the lakes can be loaded. The work of construction will be under the immediate charge of Superintendent L. S. Barr, and will continue through the winter, and employment will be given to a large force of men.

THE Barber Asphalt Company have begun work on Sixteenth Street, Omaha, to make good their contract with the city, viz, the laying of granite blocks along side the street car tracks.

WILMINGTON HARBOR, CAL.—The following was the only bid received by Lieutenant Colonel Mendell for dredging in Wilmington Harbor, Cal.:

William D. English, Alameda, Cal., $2 per yard., outside, and $1 inside Deadman's Island.

New bids for this work have been advertised for.

BUTTERMILK CHANNEL.—The following is an abstract of the proposals received by Captain Mercur for dredging shoal in Buttermilk Channel, New York:

Henry Du Bois' Sons, 33c. per cubic yard,

Morris Cummings Dredging Co., 43c. per cubic yard.

The contract has been awarded to Henry Du Bois' Sons.

GRAND MARAIS HARBOR.—There was but one bid received by Major Allen at St. Paul for dredging in the Harbor of Grand Marais, Minn., on the north shore of Lake Superior about 106 miles northeast of Duluth, Minn. The abstract of the bid is as follows:

Williams & Upham, Duluth, Minn., 25c. per cubic yard.

They have been awarded the contract.

SUNKEN LEDGES.—The following is an abstract of the proposals received by Major Raymond for removing sunken ledges in Newburyport Harbor, Mass.:

George W. Townsend, Boston, Mass., $26 per cubic yard, measured in place.

Solon S. Andrews, Biddeford, Me., $38 for same.

The contract has been awarded to George W. Townsend.

CHANNEL BETWEEN STATEN ISLAND AND NEW JERSEY.—The following is a synopsis of the bids opened by Major Gillespie at the Engineers Office, New York, Septemper 17, for dredging the channel between Staten Island and New Jersey.

Henry Du Bois' Sons, 119 South Street, New York City, 36c. per cubic yard.

Elijah Brainard and Thomas H. Benton, No. 93 Ocean Avenue, Jersey City, N. J., 20c per cubic yard.

Morris & Cummings Dredging Company, 27c. per cubic yard.

Thomas Potter, Jersey City, N. J., 27c. per cubic yard.

The contract has been awarded to Brainard and Benton.

INSIDE HARBOR AT DULUTH.—The following is an abstract of the proposals received by Major Allen, at St. Paul, Minn., for dredging in the inside harbor at Duluth, Minn.:

Chicago Dredging and Dock Co., Chicago, Ill., 20c. per cubic yard.

Chas. Fitzsimons & Chas. J. Connell, Chicago Ill., 21c., per cubic yard.

Williams & Upham, Duluth, Minn, 14c. per cubic yard.

Green Bay Dredging and Pile Driver Co. Green Bay, Wis., 16½c. per cubic yard.

Horatio Truman & George Cooper, Manitowac, Ill., 15½c. per cubic yard.

The contract has been awarded to Williams & Upham.

CANARSIE BAY.—The following is an abstract of the bids for improving Canarsie Bay, N. Y. which were opened at the Engineer's office, New York, Sept. 17:

Elijah Brainard, 20 Coenties Slip, N. Y., dredging 43c. per cubic yard; completion of dike $16,90 per lineal foot.

Henry Du Bois' Sons, No. 119 South Street, New York City, dredging 35c.; dike $29.37 per lineal foot.

Atlantic Dredging Company, 361 Fulton street, Brooklyn, N. Y., dredging 43c.; no bid on completion of dike.

The contract has been awarded to Henry Du Bois' Sons.

DREDGING BAY OF SUPERIOR.—The following is an abstract of the proposals received by Major Allen for dredging in the Bay of Superior and in the St. Louis River channel, within Superior Bay.

Chicago Dredging and Dock Company, Chicago, Ill., 20c. per cubic yard.

Charles Fitzsimons and Charles J. Connell, Chicago, Ill., 21c. per cubic yard.

Williams and Upham, Duluth, Minn , 15c. per cubic yard.

Green Bay Dredging and Pile Driver Company, Green Bay, Wis., 16c. per cubic yard.

Horatio Truman and George Cooper, Manitowoc, Wis., 16½c. per cubic yard.

Contract awarded to Williams & Upham.

CONTRACT—SIGNING ON SUNDAY.—The mere signing on Sunday of a contract which is not delivered on that day does not void the contract, according to the decision of the Supreme Court of the United States in the case of the Gibbs & Sterrett Manufacturing Company vs. Brucker, of which a report appears in the Albany *Law Journal*.

CHICAGO HARBOR.—The following is an abstract of the proposals received by Major Benyaurd for dredging Chicago Harbor, Ill.:

Green Bay Dredge and Pile Driver Co., Green Bay, Wis., 24½c. per cubic yard.

Dodge & Petrie, Little Falls, N. Y., 24c. per cubic yard.

Fitzsimons & Connell, Chicago, Ill., 24c. per cubic yard.

Chicago Dredging and Dock Co., Chicago, Ill., 23½c. per cubic yard.

The contract has been awarded to the Chicago Dredging and Dock Co.

SWAN POINT, JAMES RIVER.—The following is an abstract of the bids received by Major Hains for dredging a channel near Swan Point, James River, Va.:

Thomas P. Morgan, Washington, D. C., .144. 10c. per cub. yd.

George E. Ward, Washington, 12 25-100c.

Ross & Sanford, Jersey City, N. J., 13c.

James Caler & Son, Norfolk, Va., 23c.

Daniel Constantine, Baltimore, Md., 10 9-10.

New York Steam Dredging Company, New York city, 26c.

National Dredging Company, Wilmington, Del., 14½c.

American Dredging Company, Philadelphia, Pa., 14c.

Morris & Cummings Dredging Company, New York city, 11½c.

Thomas Potter, Jersey City, N. J., 18⅝c.

The estimated amount of dredging is 180,000 cubic yards.

The contract has been awarded to Daniel Constantine.

CONSTRUCTION OF SEWERS.—The contracts for constructing sewers in Washington, D. C., for which bids were opened on Sept. 20th, have been awarded as follows:

Thomas McCann, 3,418 feet, 4′ × 6′ brick sewer at $6 per foot; 500 feet 5,25′ × 7.87′ brick sewer $7.25 per foot; 2,170 feet of 10′ brick sewer at $15.49 per foot.

J. E. Lyon, 400 feet 45′ × 6.75′ brick sewer at $6.32 per foot.

H. L. Cranford, 2,900 feet 55′ × 8.25′ brick sewer at $10.29 per foot.

The other bidders were J. F. Joyce, B. J. Coyle & Co., F. P. Murphy, E. C. Manning, John Cox & Co., Mohler & White, J. H. O'Rouke, D. O'Hare and W. A. Wilson.

The aggregate cost of the work under the above bids is $10,000 less than that of the same work under the lowest prices bid in July 31st, which bids were rejected as informal. Had the bids received July 31st of the next lowest bidder been accepted, the cost of the work would have been $25,000 in excess of that under the above awards.

LEVEE WORK.—The following is an abstract of the proposals received for levee work (Delta to Bedford, about 24,000 cubic yards, and from Raleigh to Willow Point, about 186,000 cubic yards), and which were opened September 15th, at Memphis, Tenn., by Captain C. B. Sears, Corps of Engineers, U. S. Army:

Jas. C. Nelley, Bardwell, Ky.: 1, Delta to Bedford 23 cents per cubic yard; 2 Raleigh to Willow Point, 21 cents per cubic yard.

R. G. Huston & Co., Glendale, Ohio: 1, 24c.; 2, 21½c.

John McGinty, New Orleans, La.: 1, 24½c.; 2, 18½c.

Donnelly & Co., Memphis, Tenn.: 1, 25c.; 2, 27c.

Fruin, Bambrick & Co., St. Louis, Mo.: 1, 27c.; 2, 28c.

F. L. Maxwell, Mounds, La.: 1, 21½c.; 2, no bid.

Winters & Cooney, Memphis, Tenn.; 1, 27c.; 2, 21c.

George Arnold, Memphis, Tenn.: 1, 18⅝c.; 2, 17⅜c.

Harvey & Flynn, Memphis, Tenn.: 21½c.; 1, 2, 17⅜c.

John B. Reid, Vicksburg, Miss.: 1, 19c.; 2, no bid.

Daniel T. Hartnell & Sons, Memphis, Tenn.: 1, no bid; 2, 27c.

Robert Johnson, Memphis, Tenn.: 1, 25⅜c.; 2, no bid.

John S. McTighe, Little Rock, Ark.: 1, 28c.; 2, 26c.

Montgomery Nicholson, Illawarra, La.: 1, no bid; 2, 17½c.

Luke Madden, Delta, La.: 1, 23⅜c., and 7c. a yard for clearing grubbing; 2, no bid.

The contract has been awarded to George Arnold.

ABSTRACT of proposals received and opened by Captain E. H. Ruffner, Corps of Engineers, U. S. A., Rock Island, Ill., at 2 P.M., Sept. 5, 1884, for Dredging in Quincy Bay, Ill.

No.	Name of Bidder.	Residence.	For dredging and removing material to a distance not exceeding 1 mile. Approx. quantity, 15,000 cub. yds. Per. cub. yard.	For dredging and removing material to a distance exceeding 1 mile and not exceeding 2½ miles. Approx. quantity, 45,000 cu. yds. Per cu. yd.	Total.
1	J. W. Heisey	Burlington, Ia.	15	21	11,700
2	C. S. Whitney	Keokuk, Ia.	19⅞	21	12,421
3	C. L. Williams	" "	14	14	8,400
4	A. J. Whitney	" "	12	15	8,550
5	H. S. Brown	Quincy, Ill.	14	14	8,400
6	B. E. Linehan	Dubuque, Ia.	22	23	13,650

ABSTRACT of Proposals received and opened by Major A. Mackenzie. Corps of Engineers U. S. Army. Rock Island, M. at 2 P.M., September 5, 1884, for Ice Harbor construction at Dubuque, Ia.

No.	Name of Bidder.	Residence.	For excavating etc., and depositing in embankment approx. quantity 35,000 cu. yds. Price per cu. yd.	For excavating material and depositing at a distance not to exceed one mile approx. quantity 40,000 cu. yds. Price per cu. yd.	Total amount.
1	C. H. Booth	Dubuque, Ia.	21	16	13,750
2	J. W. Heisey	Burlington, Ia.	25	20	16,750
3	C. H. Appleton	La Crosse, Wis.	33	17½	18,550
4	C. L. Williams	Keokuk, Ia.	14	14	10,500
5	A. J. Whitney	" "	11	11	8,250
6	B. E. Linehan	Dubuque, Ia.	26	12½	14,100

ABSTRACT of all proposals received and opened the 5th day of September, 1884, at 2 P. M., by Major A. Mackenzie, Corps of Engineers, U. S. A., for furnishing stone for Construction of Dry-Dock at the Des Moines Rapids Canal.

No.	Names and Residence of Bidders.	Face Stone 300 Cu. Yds. Delivered		Backing Stone 600 Cu. Yds. Delivered		Aggregate.
		on U. S. barges in canal.	or in the river within 5 miles of the head of the canal or 1 mile of its foot	on U. S. barges in the canal.	or in the river within 5 miles of the head of the canal or 1 mile of its foot	
		per cu. yd.	amount.	per cu. yd.	amount.	
1	J. A. Greene, Stone City	11.75	3,525	9.50	5,700	9,225
2	Patterson Bros., Keokuk	8.00	2,400	5.00	3,000	5,400
3	J. S. Roper, Grafton	12.00	3,600	6.50	3,900	7,500
4	J. Mantz, Keokuk	10.00	3,000	5.50	3,300	6,300
5	E. G. Kemper, Burlington	11.50	3,450	5.50	3,300	6,750
6	J. H. Cole, Keokuk	11.00	3,300	6.00	3,600	6,900
7	Curtis & Diver, Keokuk	11.00	3,300	6.00	3,600	6,900
8	C. L. Williamson, Keokuk	12.50	3,750	6.50	3,900	7,650
9	Wm. Patrick, Phœnix, N. Y.	9.00	2,700	6.00	3,600	6,300

ABSTRACT of all proposals received and opened the 5th day of September, 1884, at 2 P. M., by Major A. Mackenzie, Corps of Engineers, U. S. A., for furnishing stone for use at the Des Moines Rapids Canal.

No.	Names and Residences of Bidders.	175 Cu. Yds. Face Stone delivered		220,000 Cu. Yds. Backing Stone delivered		5,000 Cu. Yds. Rip Rap Face Stone delivered		2,500 Cu. Yds. Rubble filling delivered		Aggregate.
		on U. S. barges in canal.	or in the river within 5 miles of the head of canal or 1 mile of its foot.	on U. S. barges in canal.	or in the river within 5 miles of the head of canal or 1 mile of its foot.	on U. S. barges in canal.	or in the river within 5 miles of the head of canal or 1 mile of its foot.	on U. S. barges in canal.	or in the river within 5 miles of the head of canal or 1 mile of its foot.	
1	J. A. Greene, Stone City, Pa	11.75	2,056.25	9.50	2,755	7.50	37,500	7.50	18,750	61,061.25
2	I. Mantz, Keokuk	10.00	1,750.00	5.50	1,595	2.25	11,250	.65	1,625	16,220.00
3	E. G. Kemper, Burlington	11.50	2,012.50	5.50	1,595	2.20	11,000	.70	1,750	16,357.50
4	J. H. Cole, Keokuk	9.00	1,575.00	6.00	1,740	3.00	15,000	.75	1,875	20,190.00
5	Curtis & Diver, "	11.00	1,925.00	6.00	1,740	2.75	13,750	.60	1,500	18,915.00
6	W. Patrick, Phœnix, N. Y.	9.00	1,575.00	6.00	1,740	4.00	20,000	3.00	7,500	30,815.00
7	Patterson Bros., Keokuk	9.00	1,575.00	5.00	1,450	2.00	10,000		1,250	14,275.00